3 PRIOR STUDIES, REPORTS, AND EXISTING WATER PROJECTS

PRIOR REPORTS AND STUDIES PREPARED BY THE CORPS OF ENGINEERS

Outlet alternatives have been the subject of many past studies. The following abridged history of Corps investigations and reports illustrates the background for the current preliminarily selected emergency outlet route and design parameters.

a. The Devils Lake Basin, North Dakota, Integrated Feasibility and Environmental Impact Statement Study (April 1988) considered flood control only and recommended a pumped storage/open channel-type outlet from the west end of the lake to the Sheyenne River. This conclusion was reached after evaluating 17 outlet options, including 14 to the Sheyenne River, one to the James River, one to the Lonetree Reservoir (a potential feature of the Garrison Diversion Unit), and deep injection wells into the Dakota Sandstone aquifer. Based on an evaluation of costs, environmental and cultural impacts, Tribal Trust lands, and in-lake and downstream water quality effects, the selected plan was a 200 cfs pumped storage/open channel-type outlet via the Peterson Coulee corridor. The plan also recommended floodplain regulation below 1440, control of future upstream drainage activities when the lake was above 1429, voluntary evacuation below 1435, and a low-flow connecting channel between East Devils Lake and the Stump Lakes and from the Stump Lakes to the Sheyenne River primarily for in-lake water quality purposes. The report was not completed.

b. The Devils Lake Basin, North Dakota, Reconnaissance Study (February 1992) looked at lake stabilization and related concerns. The study leading to this report revisited the prior outlet analysis and assessed 28 inlet alternatives and two combined inlet/outlet options identified by the North Dakota State Water Commission (NDSWC), Bureau of Reclamation, and Corps of Engineers. After comparing relative costs, environmental and cultural impacts, tribal issues, and water quality effects, the report recommended the 200-cfs pumped storage/open channel-type outlet via Peterson Coulee to the Sheyenne River and selected a 200-cfs gravity-flow inlet into the Mission Bay area of the lake delivering Garrison Diversion treated water from the New Rockford Canal via open channels and a siphon under the Sheyenne River. The report also reiterated the need for control of future upstream drainage activities when the lake was above 1429, voluntary evacuation below 1435, and floodplain regulation below 1440; however, the report deleted the low-flow connection through the Stump Lakes to the Sheyenne River.

c. In response to Public Law 102-377, a coordinated interagency effort was used in 1995 to develop the Devils Lake, North Dakota, Feasibility Study, Concept-Level Plan of Study (4 October 1995) for a comprehensive feasibility study and integrated EIS. During the 6-month collaboration of Federal, State, tribal, regional, county, and local representatives, the field of outlet routes was narrowed to Peterson Coulee and Twin Lakes on the basis of data collected and analyses done in previous studies, water quality data collected during the ongoing lake rise, recommendations of a Federal Emergency Management Agency (FEMA) Devils Lake Interagency Task Force, and qualitative

assessments of receiving water impacts and downstream acceptability. The team concluded that water quality issues precluded the practicability of outlet alternatives other than a west end outlet to the Sheyenne River because (1) the blend of river water and outlet discharge must meet the Class IA 450-mg/l sulfate standard and (2) sulfate comprises about half of the lake's TDS, which has a west-to-east gradient.

d. The Devils Lake, North Dakota, Contingency Plan (15 February 1996) looked at a variety of Federal, State, local, and private flood damage reduction measures, including thirteen 200-cfs and 500-cfs pipelines, pumped storage, and gravity-flow open channel outlet plans and combinations using the Peterson Coulee or Twin Lakes corridors. Those 13 alternatives included seven taking water from north of the Minnewaukan Flats Road in the West Bay to tap the incoming fresh Big Coulee inflows; and three involving a closure structure at Ziebach Pass (the narrow channel between the West Bay and Main Bay) to permit additional storage of incoming fresh water inflows in the West Bay, thereby increasing outlet releases within downstream water quality constraints. In addition, the Contingency Plan reported on a State proposal for a 250 cfs pump/open channel project to move about 85,000 acre-feet of Devils Lake water from East Devils Lake to the Stump Lakes. The Contingency Plan discussed costs, effectiveness, impacts, tribal issues, pros and cons, and possible implementation programs tied to future lake levels, but did not make recommendations.

e. The Devils Lake, North Dakota, Emergency Outlet Plan (12 August 1996) was to present a viable outlet plan based on existing information with the candidate plan selected from those described in the Contingency Plan. The Corps of Engineers selected the Twin Lakes 200-cfs pumped storage/open channel outlet plan for this assignment based on availability of information, engineering feasibility, construction time on an emergency basis, effectiveness, views of the Spirit Lake Tribe at that time, costs, environmental and cultural impacts, potential acceptability to downstream interests, and (prior to Public Law 105-62's ban on further inlet study) compatibility with an inlet.

f. The Summary Report on Route & Plan Selection for an Emergency Outlet from Devils Lake to the Sheyenne River, North Dakota (21 July 1997) considered seven West Bay outlet alternatives: the Emergency Outlet Plan's pumped storage/open channel plan for the Twin Lakes route, a north-to-south pipeline paralleling Highway 281, four plans along the Peterson Coulee route consisting of various combinations of pumped storage, pipeline, and open channel, and one gravity-flow tunnel paralleling the western boundary of the Fort Totten Indian Reservation. The Summary Report noted that these plans were based on an outlet capacity of 300 cfs (rather than the 200 cfs generally assumed in previous studies) because (1) as the lake continued to rise, its sulfate concentration fell, which would permit larger outlet releases to stay within the Sheyenne River's 450-mg/l sulfate standard, and (2) the NDSWC released Upper Sheyenne River Channel Capacity Study, Devils Lake Feasibility Study, Project No. 416-1 (June 1997), which conducted a hydraulic analysis of the river from Lake Ashtabula to Maddock, North Dakota, upstream of any outlet insertion point, and determined that the minimum bank-full channel capacity in the study reach was 600 cfs, instead of the 500 cfs assumed in previous analyses of outlet releases. A concurrent Corps of Engineers review of channel capacity

downstream of Lake Ashtabula verified that the upper Sheyenne River's 600 cfs was the limiting factor. The Summary Report compared the seven plans on the basis of effectiveness in reducing the lake level; cost-effectiveness; environmental, social, and cultural impacts along the Sheyenne River and Red River of the North; impacts along the outlet corridor; and implementability within a 2- to 3-year time frame. The report pointed out that these west-end alternatives would release essentially the same water quality and quantity and, therefore, would have similar drawdown effectiveness and downstream impacts. In weighing cost-effectiveness, impacts, and mitigation needs along the outlet route, and implementability, the report noted the following:

(1) The $213-million tunnel was too costly.

(2) The 11-mile, $46-million Highway 281 pipeline route and 13-mile, $25-million Twin Lakes pumped storage/open channel route were entirely on the Fort Totten Indian Reservation and crossed Tribal Trust and Indian allotment parcels, with a potential for real estate issues that could seriously impede implementation. The 14-mile-long Peterson Coulee route crossed only about 1½ to 2 miles of the reservation, all private ownership parcels. Furthermore, tribal leaders had withdrawn support for the Twin Lakes route and, while expressing a preference for an east-end outlet, had informally indicated possible support for a Peterson Coulee outlet.

(3) The two least costly Peterson Coulee plans were the $34-million pumped storage/pipeline/open channel plan and the $39-million pipeline/open channel plan. The pipeline/open channel plan had fewer en route environmental and cultural impacts; however, the impacts of either plan would be mitigated, the cost of which was included in their cost estimates.

(4) The Twin Lakes pumped storage/open channel plan and Peterson Coulee pumped storage-type plans had similar en route impacts. The report concluded that the Peterson Coulee pumped storage/pipeline/open channel plan appeared to present the best balance between cost, impacts, and implementability. These findings were presented to and endorsed by the NDSWC on 22 July 1997. Thereafter, on the basis of findings and conclusions from the long history of prior investigations and coordination with appropriate Federal, State, and local agencies, the NDSWC focused primarily on the Peterson Coulee corridor, while the Corps continued to analyze various outlet alternatives.

RECENT REPORTS BY OTHER AGENCIES

Recent reports by other agencies considering Devils Lake outlet proposals include the following:

a. The draft A Summary of Outlet/Inlet Alternates for Devils Lake (October 1995) was prepared by Ulteig Engineers, Inc., for the Garrison Diversion Conservancy District. This report developed descriptions and cost estimates (ranging from $44 million to $96 million) for 16 inlet/outlet alternatives, involving various pipeline, pumped storage, and open channel combinations generally following the Peterson Coulee, Highway 281, Twin Lakes, and Fort Totten (Main Bay) corridors. However, the report presented no conclusions or recommendations.

b. The Devils Lake-Twin Lakes Inlet/Outlet Emergency Plan (November 1996), prepared by the NDSWC, presented eight inlet/outlet alternatives: five take-offs on the Twin Lakes pumped storage/open channel plan presented in the Emergency Outlet Plan, a gravity-flow open channel following the Twin Lakes alignment, a pipeline generally following the Highway 281 corridor, and a gravity-flow tunnel east of the Twin Lakes corridor. This report included descriptions and cost estimates ranging from $21 million to over $100 million for the outlet alone, but did not make recommendations.

c. The Draft Devils Lake Emergency Response Alternatives (May 1999), prepared by the NDSWC, presented 17 options to address flooding in the Devils Lake basin. Four of these alternatives were pumped outlets including options that the Corps of Engineers studied, an option for a permanent pumped storage outlet along the Twin Lakes route and an option for a temporary pumped outlet and gravity flow through the Twin Lakes route. Other options ranged from abandoning the basin, to increasing upper basin storage, to gravity flow channels to the Sheyenne River, or discharging to the James River or the Missouri River. The report includes a discussion of each option, an estimate of the costs to construct, and the annual volume of water removed from Devils Lake.

d. A Devils Lake Surface Transportation Task Force Report (May 2000), prepared by a task force headed by the U.S. Department of Transportation – Federal Highway Administration. The task force studied options to address the safety issue of roads acting as dams, which were not constructed to function as dams. The purpose of the report was to provide information on alternatives and approximate costs to resolve the potential safety problem. Five alternatives were analyzed.

RECENT STUDIES ASSOCIATED WITH THIS REPORT

The following key separable activities have been accomplished during the preparation of the Integrated Planning Report and Environmental Impact Statement:

a. Well Monitoring – (U.S. Geological Survey). Monitored existing groundwater wells along the Sheyenne River at Kindred, Kathryn, and Cooperstown to establish a baseline and better understand impacts on groundwater from variations in river discharges (initiated in 1998). Additional wells were installed at Sheyenne in 2000. Monitoring was conducted through September 2001.

b. Water Quality Modeling/Sampling – (U.S. Geological Survey). Water quality monitoring on the Sheyenne River and Red River for the purpose of water quality verification.

c. Sheyenne Delta Vegetation Analysis – (U.S. Forest Service). Inventory location, composition, and abundance of unique plant species in the Sheyenne Delta riparian zone. Establish baseline for unique species identified at State level or of concern to USFS. Establish permanent plots for future inventory.

d. Lake Modeling – (U.S. Geological Survey). The lake model has been upgraded to include mechanisms for westward movement of salt affected by wind setup and by buoyancy flows under ice during the winter, as observed and described by Dr. Joe Manous in his thesis.

e. Cultural Reconnaissance Survey – (Hemisphere Field Services). Reconnaissance survey of cutbanks of the Sheyenne River from Peterson Coulee to the confluence with the Red River to acquire baseline data on eroding cultural resources sites. The survey was water-based; i.e., it was done using canoes. The survey did not include the Lake Ashtabula shoreline. The survey found 46 new archeological sites and relocated nine previously recorded archeological sites. In addition, 14 standing structures (three dams, two railroad bridges, three structures, and six road bridges) were recorded.

f. LIDAR Mapping – (3001). 195,000 acres along the Sheyenne River – from the upstream limit of the project to the confluence with the Red River – 1-mile width – Digital Elevation Model (DEM) point spacing of 5 m and 30-cm vertical accuracy.

g. Land Ownership Database – Create digital ownership data for all land parcels within ½ mile of each bank of the Sheyenne River for incorporation into a GIS database. The digital data will be developed using county Atlas maps.

h. Hydraulic Modeling – (RMA). Upgrade HEC-5Q model to simulate algal and nutrient response of the Sheyenne River and the Red River of the North including representing Lake Ashtabula with vertical as well as longitudinal gradients, account for concentration effects of ice, and operate Baldhill Dam with 5-foot pool raise, input DSS capability, and review update of meteorological data.

i. Evaluation of Alternatives – (Barr Engineering). The evaluation consisted of three steps: 1) Review/screen past work done on outlet alternatives and recommend a single outlet alternative to be used in Step 2; 2) Formulate alternatives; and 3) Conduct a sensitivity analysis comparing a single alternative against a no-action base condition and at least two varied future condition scenarios.

j. Upper Basin Storage Analysis – (West Consulting). Develop, calibrate, and verify an existing conditions model of the Devils Lake basin, complete long-term simulations for existing conditions with hydrologic forecasts, complete simulations with different upper basin storage alternatives, assess impacts and effectiveness of upper basin storage alternatives.

k. Traditional Cultural Properties Analysis (TCP) (Aaberg Cultural Resource Consulting). Study of the Devils Lake project area to determine whether the Spirit Lake Tribe (or other Tribes) have TCP concerns. A TCP can generally be defined as one that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) is rooted in that community's history, and (b) is important in maintaining the continuing cultural identity of the community. In addition to the Spirit Lake Tribe, the Hidatsa of the Three Affiliated Tribes, the Turtle

Mountain Band of Chippewa, the Northern Cheyenne, and the Crow are also being consulted regarding possible TCP's in the Devils Lake project area.

l. Scoping/Public Involvement – (Earth Tech). Overall program to comply with NEPA in the required scoping process, as well as keeping the general public abreast of progress on the study.

m. Fish and Wildlife Service Transfer Funding – (U.S. Fish and Wildlife Service). Coordination activities with the U.S. Fish and Wildlife Service. Scope of Work developed and agreement signed in December 2000. Work includes analysis of impacts to terrestrial resources, aquatic resources and fish hatchery activities, downstream wetland analysis, and Devils Lake terrestrial analysis.

n. Water Quality (Mercury) – (U.S. Geological Survey). The mercury sampling program is proceeding on schedule. The U.S. Geological Survey has completed the winter and spring field trips. Winter sampling included sampling under the ice at seven locations in Devils Lake and the upper basin and in Lake Ashtabula. Spring sampling included sampling at those same locations as well as nine riverine locations on the Sheyenne River, Red River, and Red Lake River.

o. Macroinvertebrate Sampling/Study – (Earth Tech). Collect baseline macroinvertebrate information. Develop a long-term monitoring procedure to collect and identify the macroinvertebrate fauna (to include invertebrates and mussels) of the Sheyenne River and Devils Lake.

p. Social/Economic Evaluation – (Peterson Environmental Consulting, Inc.). Updating and expansion on an earlier report done by Gulf Research.

q. Downstream Flooded Area – (Corps of Engineers). Hydraulic routing and mapping to define the affected area for various discharges on the Sheyenne River. Water surface profiles for the Sheyenne River were computed from Peterson Coulee to Horace for flows of 100, 300, 600, 1,000, 1,500, 2,000, 3,000, and 7,000 cfs. The water surface profiles were combined with the LIDAR mapping to determine the flooded outlines for each of the eight flows.

r. Soil Salinity – (Peterson Environmental Consulting, Inc.). Evaluation of potential impacts to soil salinity in the Devils Lake project area, including the upper basin area, around Devils Lake, and along the Sheyenne River.

s. Independent Technical Review (ITR) of Draft Integrated Planning Report/EIS – (Short Elliott Hendrickson). The ITR confirms proper selection and application of established criteria, regulations, laws, codes, principles, and professional procedures to ensure a quality product.

t. Natural Heritage Analysis – (Corps of Engineers). Natural areas identified around Devils Lake and along the Sheyenne and Red Rivers. Geographic Information Systems (GIS) will be used to identify sites affected by various alternatives.

u. Downstream Erosion Analysis – (West Consulting). Study of the Sheyenne River to determine the potential effects of a Devils Lake outlet on the river geomorphology.

v. Biota Risk Analysis – (Peterson Environmental Consulting, Inc.). Analysis of West Bay alternatives and natural overflow on the potential for the transfer of biota from Devils Lake to the Red River.

w. Aquatic Impact Analysis – (Earth Tech). Evaluation of the effects of 300 cfs constrained, 480 cfs unconstrained, and natural overflow on aquatic resources and habitat of the Sheyenne and Red Rivers. Analysis included effects on fish, invertebrates, macrophytes, algae, and mussels.

x. Groundwater Analysis – (Barr Engineering). Model or analysis of groundwater monitoring information to determine groundwater effects along the Sheyenne River.

y. Sheyenne River Terrestrial Analysis – (Corps of Engineers). Literature review of riparian vegetation. Identification of species composition, quality, and extent. To be addressed through the Fish and Wildlife Coordination Act and Corps analysis.

z. Outlet Design Development Report (Barr Engineering). Design development of the Pelican Lake Outlet. Determination of an alignment and design of major project features. Estimate cost for construction and operation.

aa. Dry Lake Diversion Feature Development Report (Barr Engineering). Review of major drainage ways and lake management practices in the upper basin of Devils Lake. Development of plans for diverting outflows from Dry Lake to Big Coulee rather than through Channel A. Preliminary design of project features. Estimate of construction costs, real estate costs, need for refuge compensatory measures, and environmental and cultural mitigation requirements.

bb. Mitigation Analysis – (Peterson Environmental Consulting, Inc.). Construction and operational impacts have been generally discussed and proposed mitigation features have been identified. Tentative management indicators for groundwater, vegetation, biota, cultural, invertebrates, water quality, soil salinity, irrigation water users, etc. are proposed. Monitoring protocol, locations, and costs have been preliminarily defined.

cc. Infrastructure Protection Study – (Barr Engineering). Developed plans for implementation of an infrastructure protection alternative – including identifying trigger points for action, quantifying issues and impacts of separable features, and identifying further NEPA documentation needs.

dd. Independent Technical Reviews (ITR's) of Separable Project Features – (Corps of Engineers' Engineering Research and Development Center (ERDC)). Using data from the Draft Report and associated support documents, ERDC performed an independent evaluation of:

- Feasibility and effectiveness of a desalination treatment plant using latest technologies available.
- Appropriateness and applicability of using the HEC5Q model for addressing water quality concerns as a simulation of impacts.
- Early detection and rapid response plan for invasive species in the Devils Lake Watershed. Analysis of invasive species in the Devils Lake watershed and potential risk for biota transfer downstream with an outlet.
- Potential for affecting bioaccumulation and biomagnification of mercury with an outlet.

ERDC also reformatted the report and developed an animation depicting varied future conditions around and downstream of Devils Lake. Work was completed in December 2002.

ee. Independent Technical Review (ITR) of the Cost Estimate – (Walla Walla District – Corps of Engineers). As the Corps' Center of Expertise for Cost Engineering, Walla Walla District independently reviewed the cost estimate of the Pelican Lake 300-cfs outlet plan and associated features. Work was completed in January 2003.

ff. Value Engineering Analysis – (Sacramento District – Corps of Engineers). A independent technical review and value engineer analysis of the environmental features of the Pelican Lake outlet plan was completed in January 2003.

gg. Fish Pathogen Study – (U.S. Fish and Wildlife Service). Survey of fish pathogens in fish from Devils Lake and the Sheyenne and Red Rivers, 2001 and 2002. Work was completed in 2002.

EXISTING WATER PROJECTS

City of Devils Lake Levee System

The levee constructed by the Corps of Engineers in 1985-1986 under the authority of Section 205 of the Flood Control Act of 1948, as amended (Public Law 88-58) was designed to protect the City of Devils Lake against a lake level of 1440 (top of levee 1445). The lake level increases in 1996 prompted the Corps of Engineers to implement the advanced measures provision of Public Law 84-99's emergency authority to raise and extend the levee, expanding the area of protection and increasing the design level of protection to 1447 (top of levee 1452) at a cost of $36 million. In September 1998, another levee raise was authorized to increase the design level of protection to 1451 (top of levee 1457) at an additional cost of $5 million, with this phase substantially completed in the fall

of 1999. Funds have been made available for preparation of plans and specifications for another 3-foot raise, increasing the design level of protection to 1454 (top of levee 1460). Stated costs do not account for costs associated with operation and maintenance. Federal and non-Federal interests cost share these levee raise costs on a 75/25 basis. A raise above a design level of 1454 will require major costs for interior drainage, since current pump stations are not designed for higher lake stages.

Because Devils Lake can remain at flood elevations for years (unlike short-term riverine flooding), the levee is designed like a dam, capable of withstanding long-term exposure to elevated water levels. Figure 3-1 shows the current alignment of the levee system, including realignments and extensions with recent raises. Those extensions more than quadrupled the levee length from its original 1.58 miles to 7.21 miles.

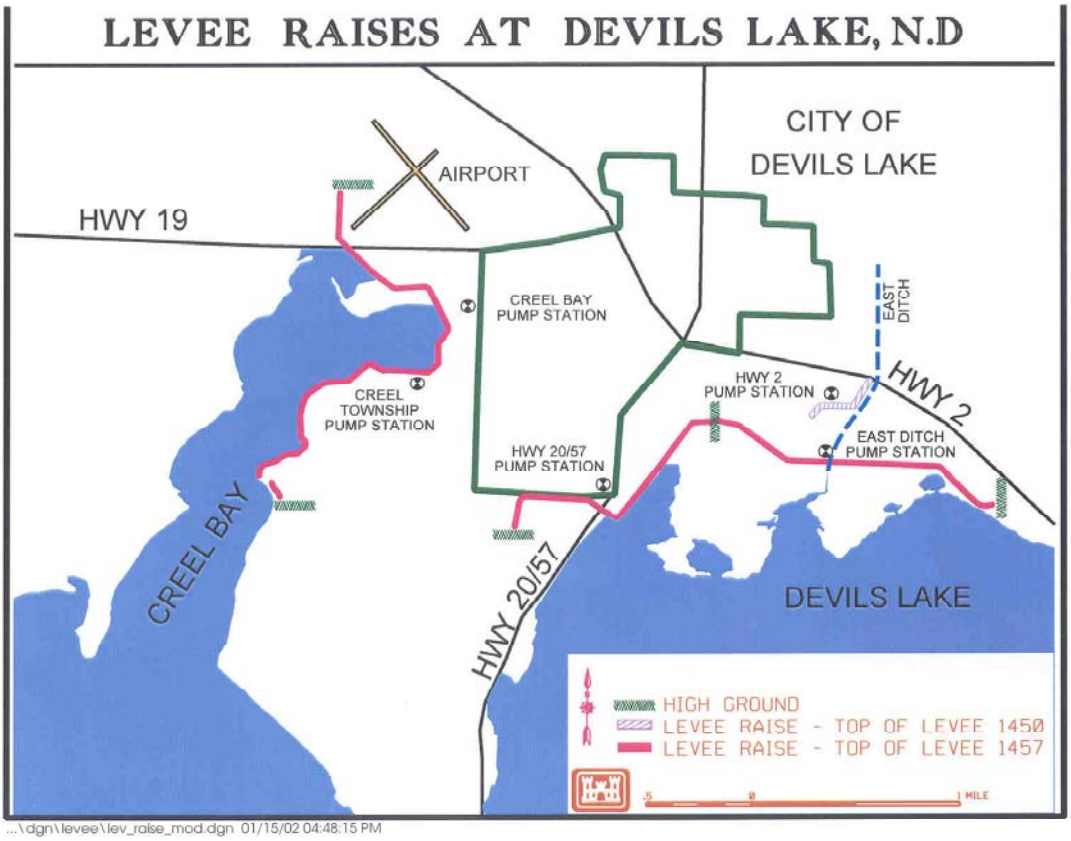

Figure 3-1: City of Devils Lake Levee System

Transportation Facilities

The rising lake has caused major flood-related damages and associated costs to transportation facilities (Federal and State highways, county and township roads, railroads, etc.). For example, since the current lake rise began in 1993, the Federal

Highway Administration, Bureau of Indian Affairs (BIA), North Dakota Department of Transportation, counties, and townships have spent and programmed over $140 million for road raises and repairs and bridge replacements. The list of key roads involved includes U.S. Highway 281; North Dakota Highways 19, 20, and 57; BIA Roads 1, 2, 5, 6, and 9; Woods-Rutten Road; and Grahams Island Road. Some of these roads have been rebuilt three or four times, but at times the lake has risen as fast as construction crews have raised the roads. Bridge replacements are also necessary to accommodate higher flows along streams entering Devils Lake. New bridges at Big Coulee on U.S. Highway 281 and Highway 19 were constructed in 1998. High lake levels continue to threaten other area bridges. Area flooding has also affected many local roads.

In addition, millions of dollars in costs have been incurred by businesses and the general public due to the extra travel distance and time because of detours from permanent and temporary road closures and almost constant construction as agencies respond to the rising lake. For instance, in 1997, the lake level rose 5 feet and cut off the Highway 20 and Highway 57 crossings of The Narrows, the major routes between the Spirit Lake Reservation, and the City of Devils Lake. The resulting detours to the east via Woods-Rutten Road and west via Highways 19 and 281 added up to 50 miles of one-way travel for school buses, emergency vehicles, employees and customers of businesses, etc.

Gravel surfaces and potholes along main roads undergoing raises and along secondary roads carrying traffic volumes and loads (including heavy construction equipment) well beyond their design capacity have caused a significant, but unquantified increase in vehicle wear and tear. In addition, transportation safety issues have increased because of visibility problems on long stretches of dusty road raises, miles of causeways with water on both sides of the road instead of grassy ditches, extra miles of icy roads from wind-blown spray, and wave-related erosion and sub-bases softened from a high water table. For example, in 1998 and 1999, train derailments and accidents occurred because of the softened rail beds.

North Dakota Highway 19 has been raised at four locations, with two of these locations requiring new bridges. The roadway was raised to elevation 1455 and bridges to elevation 1465. U.S. Highway 2, west of Devils Lake, has been raised to elevation 1455 and the bridge at Mauvais Coulee near Churchs Ferry to elevation 1467.7. The bridge on North Dakota Highway 20 was raised to elevation 1465 and the roadway raised to 1455. North Dakota Highway 57 (also referred to as Bureau of Indian Affairs (BIA) Road 15) has been raised to a minimum level of elevation 1456 feet. Highway 1 has been relocated around Stump Lake and raised to a minimum elevation of 1465 feet. Woods-Rutten Road was raised and is open for traffic. BIA Highway 6 has been raised to a minimum elevation of 1457. BIA Highway 1 has been raised to a minimum elevation of 1451. U.S. Highway 281 has been raised to a minimum elevation of 1451 feet.

The Burlington Northern Santa Fe (BNSF) Railroad line, which runs from Minot to Grand Forks, North Dakota, also carries the Amtrak passenger service. With the top of rail elevation at elevation 1451 feet above mean sea level (msl) in the Churchs Ferry area, the BNSF considered rerouting this line through New Rockford to Fargo, bypassing

Rugby, Devils Lake, and Grand Forks, rather than raising the line, if the lake continues to rise. However, through a cost-shared agreement with the State and local governments, the line has been raised to a minimum elevation of 1456. The Canadian Pacific Railroad runs directly west of the City of Devils Lake on an alignment to the north of and parallel to Highway 19. The top of rail is at a minimum elevation of 1450, and therefore has not yet been flooded. However, this railroad has been closed since 1998 because its embankment has been damaged by erosion where it crosses several miles of open water.

Other Communities, Rural Areas, and Infrastructure

The rising lake level has caused significant impacts around Devils Lake since 1993. As the waters rise, area population continues to decline as waters inundate the surrounding communities and residences.

Property owners outside the city levee and near shorelines rely on flood insurance and, to a limited extent, on physical barriers, such as sandbag dikes, to protect their properties. Recognizing the unusual flooding situation at Devils Lake, the Federal Emergency Management Agency (FEMA) issued a "Continuous Lake Flooding Waiver" under its National Flood Insurance Program (NFIP) from 1996 to 1999. Under this program, homes below the maximum lake level forecasted by the National Weather Service for that year were considered total losses before the lake reached them. This allowed structures to be relocated before the ground became too soft for moving equipment or homes were destroyed by wave or ice action. Since 2000, FEMA has added a closed lake basin endorsement to its flood insurance policies. This endorsement allows for similar actions. Since 1996, the NFIP has paid over $23.5 million on approximately 700 claims. In addition, in 1997 and 1998, the BIA and the Spirit Lake Tribe moved 99 reservation homes at a cost of approximately $11 million. They anticipate having to move an additional 65 homes over the next few years.

Rising lake levels have also affected the Ramsey County Rural Utilities sanitary sewer system. The original system was constructed in 1983 with assistance from the Environmental Protection Agency at a cost of $8 million. The intent was to eliminate the potential for lake contamination from inadequate individual sewer systems along the north shore of Devils Lake. This system served 657 customers in 1993. To date, 204 homes have been forced to disconnect as houses, sewer lines, and lift stations were lost to the rising lake, jeopardizing the economic viability of the whole system. Also, the system's normal sewage volume more than doubled because lake water flowed into inundated manholes and infiltrated pipeline joints. Because the rural sewer system discharges into the City of Devils Lake wastewater treatment facility, the rural system's excess flows caused the city's facility to operate above design capacity, compromising retention times.

Federal funds in the amount of $850,000 were made available through 1997 and 1998 emergency supplemental appropriations for repairs and preventive measures for the rural sewer system. These funds were matched with non-Federal funds on an 80/20 cost-sharing basis to replace portions of the gravity feed system with force mains, raise lift

stations, relocate some portions of the gravity line to higher ground, and floodproof numerous cleanouts, lift stations, septic systems, and manholes to reduce intrusion of surface water into the system.

Rising lake levels have had similar effects on residences and utilities and other communities around Devils Lake. Numerous houses have been affected by rising lake and groundwater levels, forcing homeowners to abandon or relocate their homes. Sewage facilities in Minnewaukan and at the Fort Totten Indian Reservation have been affected, requiring modification or relocation to remain functional. In addition, many private wells and septic systems have been adversely affected. Communities like Minnewaukan, faced with rising waters and infrastructure problems, have held meetings in search of residents' opinions and to discuss options for the city. Among the alternatives discussed were rerouting a portion of U.S. Highway 281, building a dike to protect the city, buying out individual homes and property, and relocating the city.

The community of Churchs Ferry (population of 120 in 1999), 20 miles northwest of Devils Lake, was part of a FEMA buyout, which for the most part was completed in 2000. Of the 56 homes in Churches Ferry, 52 have been purchased: 33 homes were demolished and 19 homes were moved. Of the six commercial structures in the community, four were razed, and two were moved. The BTR elevator and a church have not been bought out at this time.

The Fort Totten Indian Reservation, located on the southwest side of Devils Lake, also faces flooding difficulties. Rising lake waters have damaged many house exteriors, and interior problems have resulted.

Homeowners on the Fort Totten Indian Reservation have experienced water seepage in basements causing moisture and mold problems. Sewer systems and water supplies have been affected as residents have not been able to use or drink the water. Other infrastructure both on and off the reservation affected by the rising lake includes scores of individual septic systems and private wells. In the summer of 2001, the high water table resulted in flooding of at least 15 homes within the Fort Totten Indian Reservation and the presence of water in basements of another 20 homes in the town of Warwick. The high water table has also caused the main concrete slabs to rise at 12 homes in Fort Totten.

Western Area Power Administration, United Power Association, Otter Tail Power Company, Northern Plains Electric Cooperative, and North Dakota Telephone Company have miles of power and telephone lines running under or around the lake or on towers across the lake. These companies have already incurred or foresee incurring millions of dollars in expenditures to relocate, replace, and elevate equipment and facilities.

Park and recreation facilities around Devils Lake including Grahams Island State Park and access roads, Shelvers Grove, Black Tiger Bay, the Narrows, National Wildlife Refuges on Stump Lake and Lake Alice, and Spirit Lake Casino have also incurred thousands of dollars in damages and have lost visitation, despite millions of dollars spent

to raise and relocate facilities and access roads around the lake. For example, $2.2 million was spent to raise and reroute the Grahams Island State Park access road. The Narrows, part of the Devils Lake State Park System, has been underwater since 1996. Since the flooding began, Grahams Island alone has lost over $1 million of infrastructure. Rising lake levels have severely affected the rural economy around Devils Lake. Many of the farms and ranches bordering the lake have been forced to abandon operations because of the loss of pasture and croplands. At a current approximate lake stage of elevation 1447, the lake covers 137,000 acres, an increase of about 93,000 acres (approximately 145 square miles) since 1993. At an average land value of $600 per acre for non-urban lands, this represents a loss of over $55 million. Because agriculture is the cornerstone of the local economy, the current set of problems could have regional ramifications.

Channel A

Channel A is an outlet channel from Dry Lake to Six-mile Bay of Devils Lake. Channel A was constructed by the North Dakota State Water Commission in cooperation with the Devils Lake Joint Water Resources Board. Since the natural drainage patterns from Dry Lake went into Chain Lake, Lake Alice, and Lake Irvine before reaching Devils Lake via Mauvais Coulee, this route caused lake levels in these upstream lakes to be high for long periods during flood runoff. Channel A provides a shortcut connection to Devils Lake by cutting through the drainage divide to Six-mile Bay. During the spring runoff of 1979, Channel A was put into operation to reduce flooding around Dry Lake and other lakes adjacent to it by lowering the level faster than would have occurred through use of its natural outlet. Substantial controversy surrounded the construction of Channel A. Many wildlife interests opposed the project. One of their concerns is that Channel A gets the water to Devils Lake faster than under natural conditions and results in higher levels on Devils Lake. Although estimates have been made that show this situation does have a minor effect on increasing lake levels, this is still an item of controversy in the region.

Baldhill Dam/Sheyenne River

Baldhill Dam, located about 11 miles northwest of Valley City, was originally constructed in 1950 as a multipurpose project for water supply, pollution abatement, and flood control, and is now additionally operated for recreation purposes. The reservoir, Lake Ashtabula, is 27 miles long at normal pool level. The project provides limited protection from floods downstream of the dam, primarily at Valley City. It also provides sufficient water flow during dry periods to meet the water supply needs of municipalities and rural areas along the Sheyenne River and the Red River of the North. So that part of the water from the Sheyenne River may be diverted to Fargo for water supply, local authorities constructed a low diversion dam and pipeline. Fargo used this diversion as the principal source of water supply for several months during the winter of 1976-77 when the Red River of the North went dry.

Additional flood control improvements on the Sheyenne River were authorized in the Water Resource Development Act of 1986. Of the four separable units, two downstream elements have been constructed, one was found to be infeasible, and one is under construction. The Horace Unit, which consists of 7.4 miles of flood diversion channel and 14.8 miles of levee from Horace to West Fargo, was essentially completed in 1992. The West Fargo Unit, which consists of 12.7 miles of levees and a 6.8-mile diversion channel at West Fargo, was essentially completed in 1994. An economic evaluation was completed in October 1990 for a dam and reservoir with approximately 35,000 acre-feet of storage for flood control on the Maple River; however, it was determined that this project increment does not warrant further Federal involvement. The final unit of work, a 5-foot raise of the Baldhill Dam flood control pool, is scheduled for completion in 2003. This project will increase the storage for spring floods from 39,000 acre-feet to about 70,000 acre-feet.

Evaluations to determine compliance with Dam Safety Assurance Program criteria revealed that the dam had inadequate spillway capacity. A new 880-foot-long emergency spillway, plus other measures, was completed between 1994 and 1999. The spillway capacity, which was originally designed for 43,100 cfs, now provides a hydraulic capacity of 122,000 cfs.

Valley City

The existing flood protection measures in Valley City consist essentially of earthen dikes with sandbagging required in areas where there is insufficient room to construct an earthen dike or where the existing ground is relatively high and only a minimal raise is needed. The levees were constructed over a period of time from 1969 through 1997, generally with Public Law 84-99 funds. The existing levees reduce average annual damages at Valley City by about 10 percent.

4 DESCRIPTION OF STUDY AREA

GENERAL DESCRIPTION OF STUDY AREA

Devils Lake Basin

Devils Lake and its watershed comprise a significant portion of the State of North Dakota (5 percent) and of the drainage area of the Red River of the North at the United States and Canadian border (9 percent). The topography of the watershed results in essentially the entire watershed draining into Devils Lake and then, at times, into the Sheyenne River. Over the past several thousand years, the level of Devils Lake has fluctuated greatly, with approximately 65 feet of elevation difference from its lowest level to its highest level. Devils Lake is usually a closed basin, but under extreme high water conditions, it flows to Stump Lake and then to the Sheyenne River, thus contributing flow to the Red River. Devils Lake is a terminal lake with no outlet at the current elevation. The last spill is estimated to have occurred 800 to 1,200 years ago. These characteristics result in an unusual situation at Devils Lake related to flooding of land and developed areas around the lake and within the watershed, water quality within Devils Lake, and relationship of the Devils Lake basin to the Red River of the North. The lake reached the highest level in July 2001 since before 1867, when record keeping was started. The lake level has been increasing since 1940; much more dramatically since 1993, with significant flood damages occurring around the lake.

The 3,814-square-mile Devils Lake watershed, located in northeastern North Dakota, is a hydrologic subbasin of the Sheyenne River, which in turn is a subbasin of the Red River of the North basin (Figure 4-1). The lake level must exceed an elevation of 1459 feet msl to spill to the Sheyenne River. Devils Lake's level of 1448.33 in July 2001 is the highest stage on record. Modeling of Devils Lake indicates that the probability of a spill to the Sheyenne River sometime during the next 50 years is estimated to be 0.094. However, the lake level has risen over 47 feet since the historic low in the 1940s, with a 25-foot rise since 1993. Since record keeping began in 1867, the lake level fell from 1438.4 to its historic low of 1400.9 in 1940 and rebounded to its current historic high of 1448.33 in July 2001 (Figure 4-2).

The variability in lake levels results from Devils Lake being a "terminal lake" (i.e., a closed basin), unless exceptional conditions are present. It is believed that the lake has gone from completely dry to overflowing to the Sheyenne River, an elevation range of approximately 65 feet, several times since the lake was formed by the last glacial episode about 10,000 years ago. Figure 4-3 illustrates the lake level's variability over the past 4,000 years based on geologic evidence analyzed by the North Dakota Geological Survey (NDGS). On the basis of that evidence, Dr. John Bluemle, State Geologist, says that the lake's natural condition is either rising or falling in response to climatic changes; therefore, it should not be expected to remain stable. He also concludes that man's impact on lake levels from agriculture, wetland drainage, and road construction is minor.

Figure 4-1: Location of Devils Lake Basin

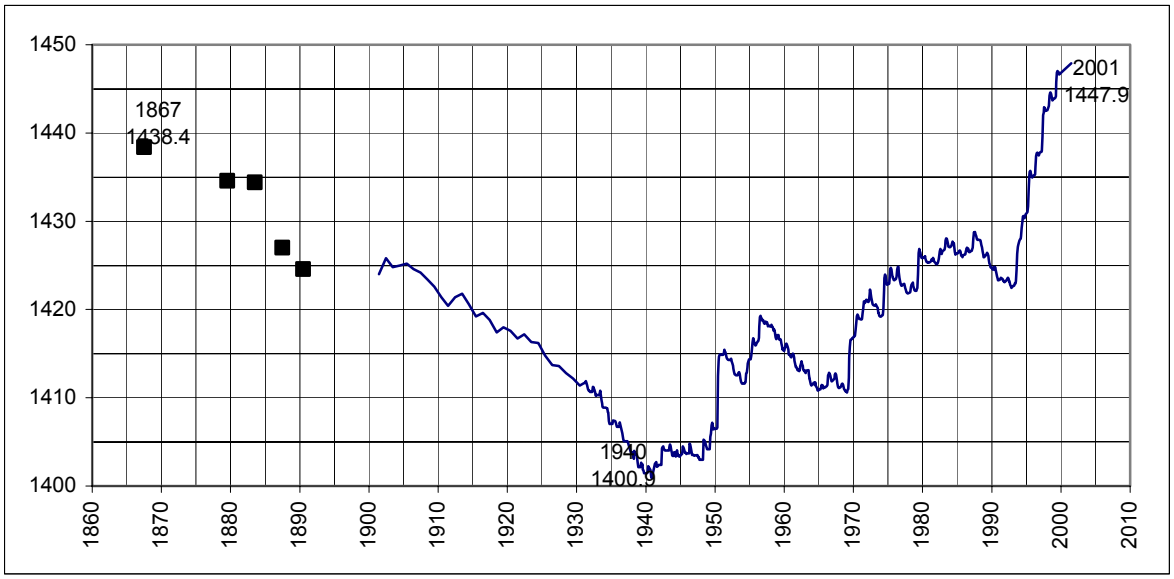

Figure 4-2: Devils Lake Historic Records

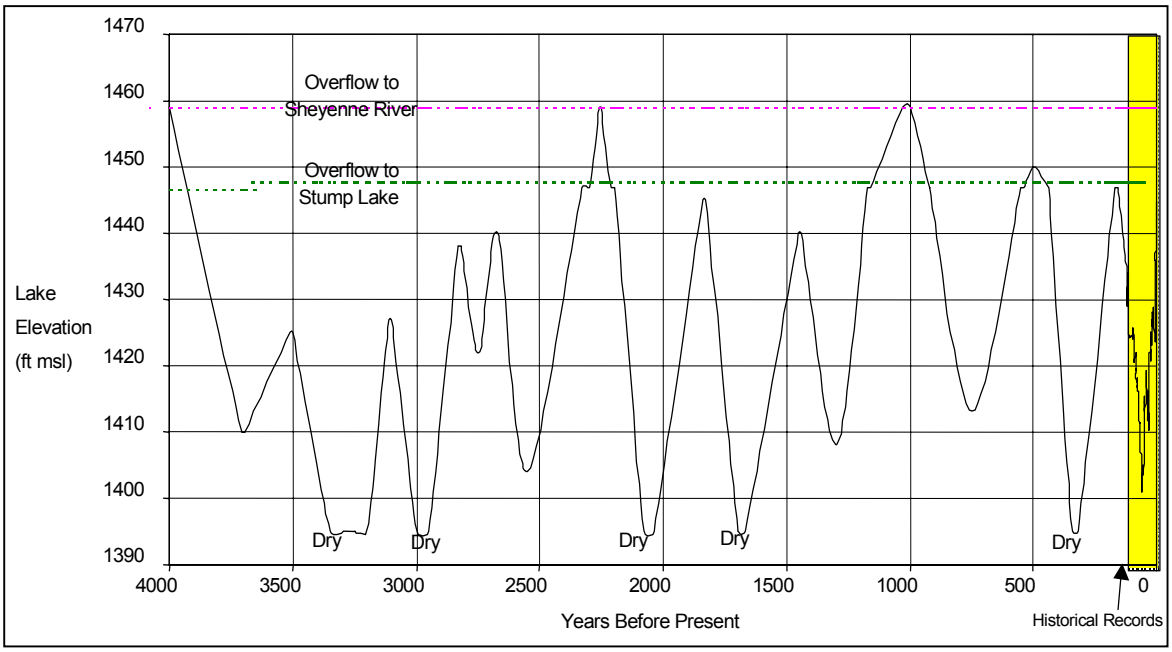

Figure 4-3: Devils Lake Fluctuations – 4,000 Years

Historically, Devils Lake and the surrounding wetlands, prairie, and forests had supported Native Americans for centuries, and, in the mid-1800s, Euro-American settlers started migrating to the area. By the 1880s, Devils Lake and the surrounding area were experiencing a significant change in character with the development of commercial navigation, a resort industry, rural towns, and the conversion of the prairie to agriculture. In the early 1900s, a falling lake signaled the end of commercial navigation and a cutback in resort activities. Farming became the principal economic factor in the Devils Lake basin. The present economy is still largely dependent on agriculture; however, the recreation industry (fishing, hunting, and water-based activities) is a multi-million dollar business.

Devils Lake and vicinity is illustrated in Figure 4-4. The City of Minnewaukan is located on the west end of the lake, the City of Devils Lake on the north, and the Fort Totten Indian Reservation on the south. The majority of the Devils Lake watershed drains into the west end of Devils Lake, either through Big Coulee into the west bay of Devils Lake or through Channel "A" [1] into the main bay of Devils Lake. The natural overflow channels from Devils Lake to the Sheyenne River are located on the east end of the lake, with Devils Lake first overflowing into the Stump Lakes and then from the Stump Lakes into the Sheyenne River near Tolna.

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[1] *Channel A is a non-Federal flood control diversion channel, opened in 1979, which intercepts runoff from about 890 square miles in the northeastern part of the Devils Lake watershed. The natural course for that runoff was through a chain of freshwater lakes into Big Coulee and, eventually, the West Bay. Instead, Channel A redirects that flow into Sixmile Bay of Devils Lake.*

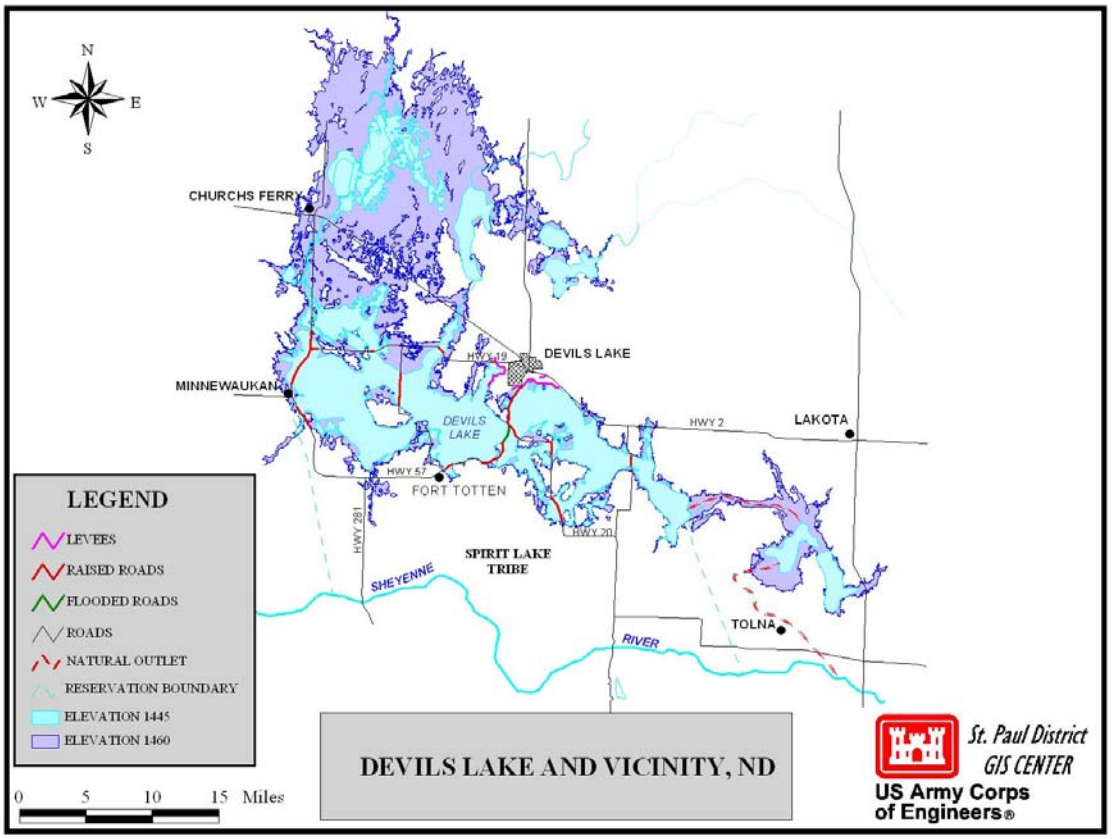

Figure 4-4: Devils Lake and Vicinity

Devils Lake consists of several "bays" that join or separate from the main body of water depending on the lake level. Figure 4-5 presents a view of the cross section through the lake from west to east and shows how high ground between the bays causes them to join or separate as the lake rises or falls. At its elevation of 1446.9 in March 2003, Devils Lake is flowing into the Stump Lakes at a rate of less than 20 cfs.

Like the Great Salt Lake in Utah, another consequence of Devils Lake's closed basin is high salinity, expressed in terms of total dissolved solids (TDS) brought into the lake via inflows from the drainage basin. An analysis of data from 1993 to 1999 showed that TDS concentrations in the Big Coulee and Channel A inflows averaged 455 and 483 milligrams per liter (mg/l), respectively, which are comparable to the Sheyenne River's 480 mg/l average between 1951 and 1997. *[Note: The concentration units of mg/l are equivalent to parts per million. Therefore, a concentration of 450 mg/l TDS means that there are 450 parts of total dissolved solids per each 1,000,000 parts of water.]*

The TDS concentration in Devils Lake is higher than that of Big Coulee and Channel A because evaporation from the lake's surface concentrates the TDS. This is particularly

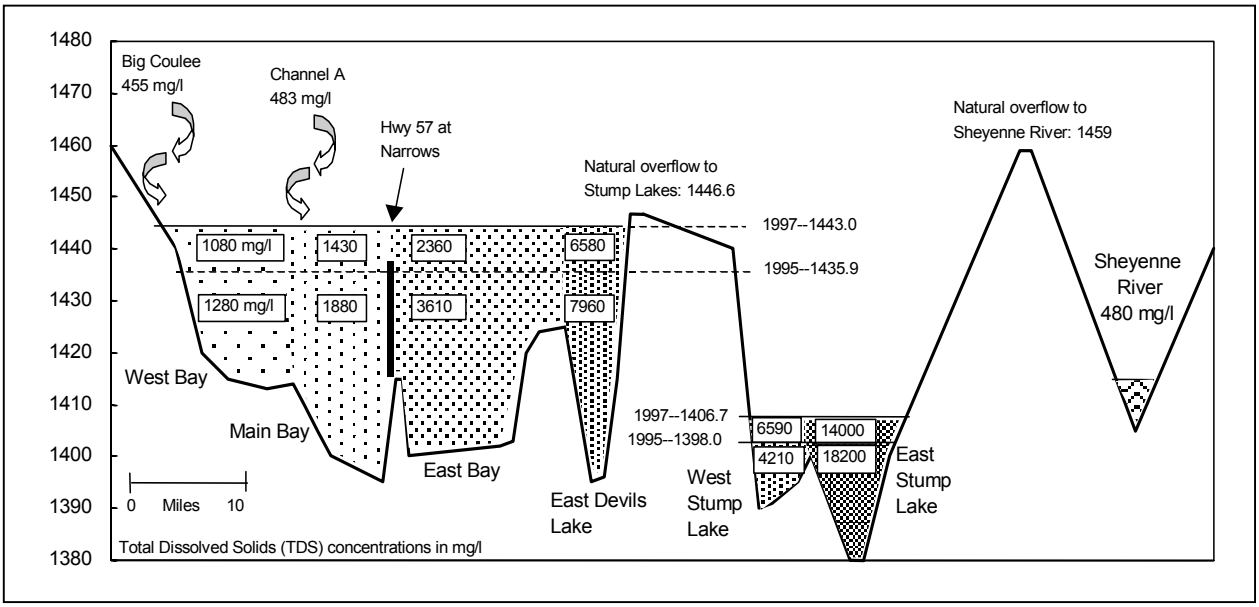

Figure 4-5: Devils Lake – West-to-East Cross Section

evident when evaporation equals or exceeds inflows, causing the lake level to be steady or to fall. Conversely, TDS in the lake decreases when major freshwater inflow events dilute the lake's TDS and raise the lake level.

The level of TDS in Devils Lake increases from west to east because most freshwater runoff from the watershed enters the western end of the lake via Big Coulee into West Bay and Channel A into Main Bay by way of Six-mile Bay. Figure 5 illustrates TDS variability with lake level and location. In 1995, with the lake elevation at 1435.9, TDS ranged from about 1,280 mg/l in the West Bay to about 7,960 mg/l in East Devils Lake. In 1997, with the lake elevation at 1443.0, TDS ranged from about 1,080 mg/l in the West Bay to 6,580 mg/l in East Devils Lake. East and West Stump Lakes joined together between 1995 and 1997 when their level increased from 1398.0 to 1406.7. East Stump Lake TDS decreased from 18,200 to 14,000 mg/l, whereas West Stump Lake TDS increased from 4,210 to 6,590 mg/l with the mixing of the two lakes.

Figure 4-6 illustrates how the lake's surface area increases as the lake level rises, with most of that expansion occurring to the west and north, inundating primarily pasture and agricultural lands. When the lake reached its historic low of 1400.9 in 1940, the lake's surface area was only about 10 square miles, confined to the main bay of the lake. Just prior to the sustained lake rise of the last 8 years, the lake level in 1993 was at 1422.5, with a surface area of 44,000 acres (68 square miles). The lake currently has a surface area of 137,000 acres (214 square miles). If the lake reaches 1459 and spills to the Sheyenne River via Tolna Coulee, the surface area would be 278,000 acres (433 square miles), including the Stump Lakes. If the lake continued to rise until its outflow balances inflow, probably to a maximum of about 1463 at the west end, the surface area would be approximately 354,000 acres (553 square miles).

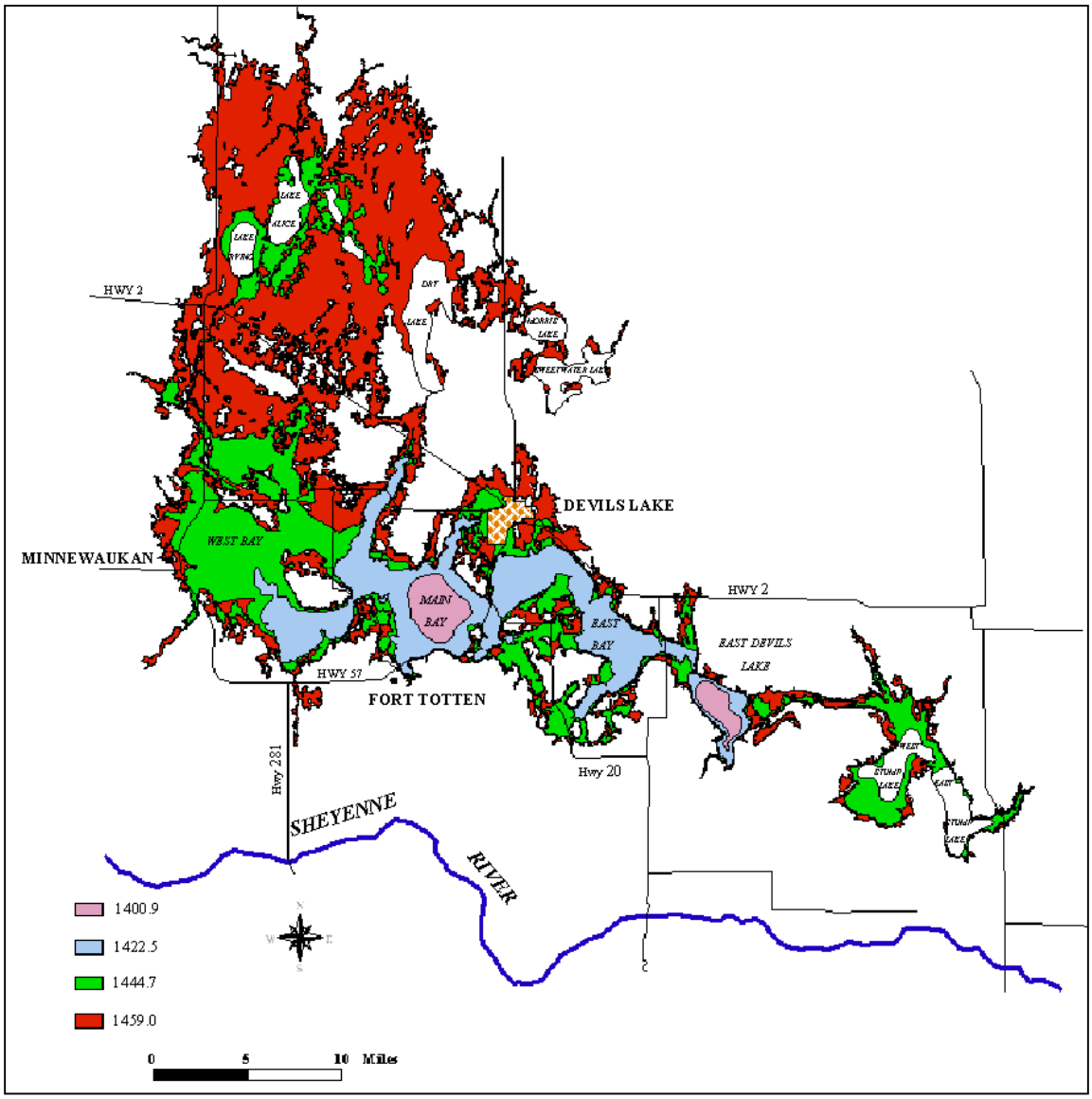

Figure 4-6: Devils Lake at Various Elevations

Figure 4-7, the plot of lake area by elevation, shows that each foot of lake rise inundates a progressively greater area; for example, a 1-foot increase at elevation 1420 adds about 2,300 acres to the lake's surface area, whereas a 1-foot increase at elevation 1450 adds nearly 10,000 acres. Correspondingly, Figure 4-8, the plot of lake volume by elevation, shows that as the lake elevation gets higher, each foot of lake rise takes a greater volume of inflow. For example, a 1-foot increase at elevation 1420 requires another 39,000 acre-feet of water, whereas a 1-foot increase at elevation 1450 requires 151,000 acre-feet of inflow. This physical characteristic of the lake tends to have a self-dampening effect on lake-level fluctuations. As the lake rises, there is a self-dampening effect on further rises because of the combination of a need for a greater volume of water for the next increment of rise plus an increased volume of lake water lost to evaporation from the larger surface

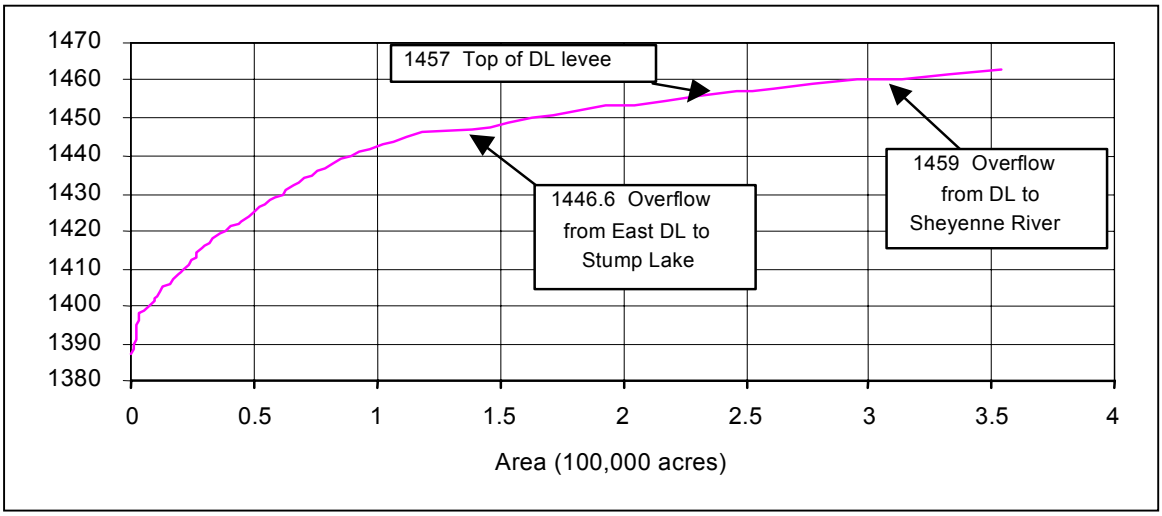

Figure 4-7: Devils Lake Elevation-Area Relationship

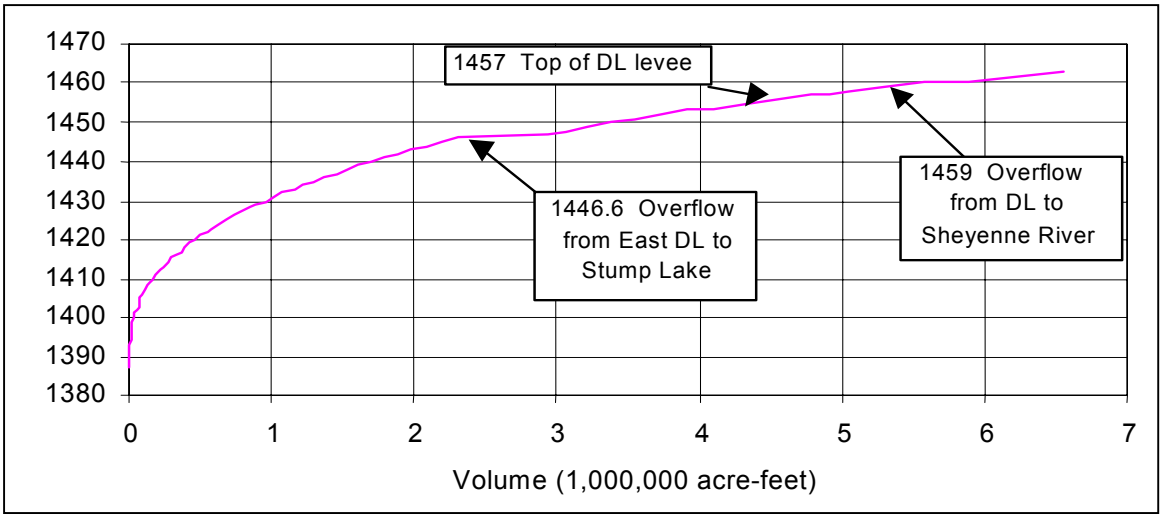

Figure 4-8: Devils Lake Elevation-Volume Relationship

area. Likewise, as the lake falls, there is a self-dampening effect on further falls because, at low lake level, the reduced surface area means that evaporation losses are less and that a smaller volume of water is needed for an incremental rise.

Area Downstream in the Red River of the North Basin

Any flow out of the Devils Lake basin, whether it be a natural overflow or from a man-made outlet, would flow into the Sheyenne River. The Sheyenne River basin covers parts of 16 counties in the southeastern portion of North Dakota and drains an area of 6,910 square miles. A natural overflow from Devils Lake would flow through Tolna Coulee into the Sheyenne River, which is 394.5 miles upstream of the confluence with the Red River of the North.

The Sheyenne River basin lies in two distinct topographic areas: the rolling drift prairie, which includes all of the basin upstream from the escarpment of the Sheyenne Delta near Kindred; and the flat Red River Valley plain through which the lower 70 miles of the river passes. The Red River of the North valley floor ranges in elevation from 890 near the mouth of the Sheyenne River to 950 at the margin of the delta near Kindred. The top of the delta escarpment varies between elevations 1000 and 1020. From the fringe of the delta westward, the elevations of the upland areas range from 1020 to 1700. The Sheyenne River valley above Kindred varies in depth from 100 to 200 feet and ranges in width from ¼ mile to 2 miles. Of the total basin area, about 92 percent is in farms and about 83 percent of the farmland is cultivated. Timber is limited to a fringe along the Sheyenne River; however, portions of the river above Kindred are heavily wooded. The average slope of the river is 1.6 feet per mile.

Baldhill Dam, located 271 miles upstream of the confluence with the Red River of the North, forms Lake Ashtabula. This Corps of Engineers dam and reservoir was authorized and is operated primarily for low-flow augmentation to meet downstream water supply and pollution abatement requirements and to alleviate flooding downstream. The reservoir has a storage capacity of 70,600 acre-feet at the conservation pool elevation of 1266.0 feet. With a recently authorized 5-foot raise in the design pool level (to elevation 1271), there is a total storage capacity of approximately 100,000 acre-feet. The minimum channel capacity upstream of Lake Ashtabula is approximately 600 cfs, and downstream of Lake Ashtabula, the channel capacity is approximately 2,000 cfs.

The Sheyenne River flows into the Red River of the North immediately downstream of Fargo, North Dakota. From this point of confluence to its entry into Lake Winnipeg, the Red River of the North will flow approximately 424 miles. It is part of the Hudson Bay drainage system. The Red River of the North drainage basin is the remnant flat lakebed of the former glacial Lake Agassiz. The two most important physical features of the Red River of the North with respect to flooding are that the direction of the flow is to the north and the river gradient is very flat. The slope of the river averages about ½ foot per mile, varying from approximately 1.3 feet per mile in the vicinity of Wahpeton, North Dakota, to 0.2 foot per mile near the international border and less slope than this in Canada. The meander bends of the main channel cause the effective channel length to be about twice the length of the basin. Channel widths vary from 200 to 500 feet, and average depths at bank-full stage range from 10 to 30 feet. Examples of channel capacities in the Red River of the North are approximately 15,000 cfs at Halstad and over 30,000 cfs in Manitoba. Land use in the basin is about 75 percent agricultural, with about 66 percent of the basin in cropland.

5 PLAN FORMULATION

PROBLEMS AND OPPORTUNITES

Flood Damages

As discussed earlier, much has been done in reaction to rising lake levels, with most of these measures providing protection from lake stages only slightly higher than current levels. There is a high level of anxiety within the Devils Lake basin centered around the uncertainty of how much higher the lake will rise.

Devils Lake flooding is different from riverine flooding. A river rises relatively abruptly, has a duration generally measured in terms of days or weeks, and then returns to normal, with next year's flood potential independent from any prior year's flood. In contrast, Devils Lake rises relatively slowly, starting with the spring runoff and peaking in the summer when increasing evaporation and decreasing flows reach a balance. Each succeeding year's flood potential is directly related to the prior year's lake level. Therefore, a series of what would be relatively modest riverine flood events can add up to a major lake flood.

An inventory of remaining buildings and infrastructure that could be affected by a continued lake rising was completed by Hazard Mitigation Economics Inc. (HME) in September 1999. The inventory separated out the area protected by the City of Devils Lake levee. Within this area, 1,393 structures were identified. The value of these structures and infrastructure items between elevations 1429 and 1460 was estimated to be $210.4 million. Outside the levee for the City of Devils Lake, there is estimated to be over $767 million at risk between the current lake level of 1447 and elevation 1460. The most valuable items are the roads and highways in the basin, with a total replacement value of $580 million. Also, an additional 163,000 acres of land would be flooded at a lake level of 1460.

Devils Lake has risen above elevation 1446.5, the divide in the Jerusalem Outlet between East Devils Lake and West Stump Lake; however, Figure 5-1 shows that Devils Lake would have to rise to 1449.0 before there would be a significant flow (say, 300 cfs) to the Stump Lakes. At that rate, it would take about 2 years to fill the Stump Lakes. Damages from an overflow to the Stump Lakes include loss of State Highway 1 and county and township roads along the Jerusalem Outlet and around the Stump Lakes, several residences, the West Stump Lake Wildlife Refuge, a county park, and 8,000 acres of primarily pasture and woodland. Such a spill would reduce the overall TDS in the Stump Lakes from its current composite of over 11,000 mg/l to about 6,000 mg/l.

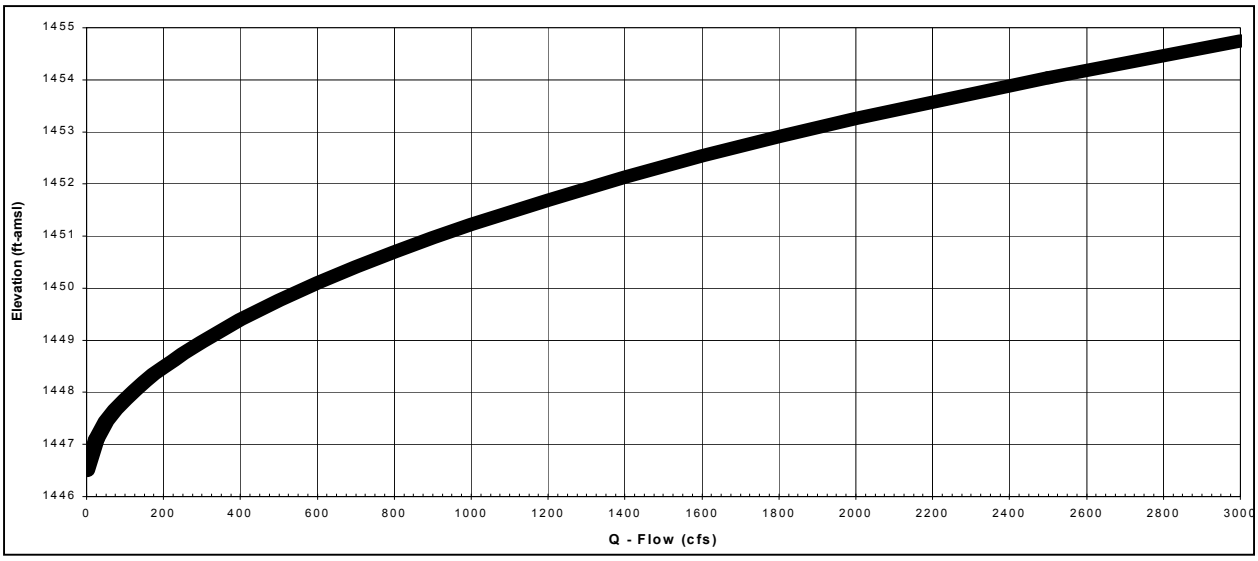

Figure 5-1: Rating Curve for Devils Lake to Stump Lake with Existing Conditions

At elevation 1459, Devils Lake would overtop the divide in the Tolna Coulee outlet between West Stump Lake and the Sheyenne River. Figure 5-2 shows rating curves for various overtopping elevations. Assuming no erosion at the natural overflow area, Devils Lake would have to rise to 1460.6 before there would be a significant flow (at least 300 cfs) to the Sheyenne River. If, for instance, the natural overflow had eroded to elevation 1458, that same 1460.6 lake stage would cause flows of about 1,600 cfs to the Sheyenne River. Computer simulations of possible future lake levels assumed no erosion of the natural divide[1] and suggest a probable maximum lake level of about 1463, with a corresponding outflow exceeding 2,500 cfs (vis-à-vis the minimum bank-full channel capacity of about 600 cfs in this reach of the river). On the basis of results from the stochastic model, the water quality during these spills would vary depending on events prior to and during the spills, with a median TDS of over 3,700 mg/l with maximums up to 6,800 mg/l, compared to a 480 mg/l average in the river, and median sulfate of nearly 1,900 mg/l with maximums near 3,400 mg/l, compared to a 100 mg/l average in the river and 450 mg/l standard for this Class 1A stream. Although a complete analysis of the downstream impacts from an uncontrolled breakout of that size and water quality has not been completed, it is likely that there would be serious flooding at least in the upper Sheyenne River (above Lake Ashtabula) and possibly in the lower Sheyenne River depending on the concurrent natural flow in the river, serious bridge damages or washouts, major riverbank erosion, and disruptions to surface water users (Valley City, irrigators, etc.) that could not tolerate that degree of water quality degradation.[2] Severe

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[1] *Appendix B includes a section on Tolna Coulee erosion. If the divide is not protected from erosion, it could degrade by as much as 9 feet, increasing the peak discharge by approximately 6,000 cfs, assuming a wet future scenario, and significantly increasing the volume released downstream.*

[2] *Data on towns downstream of Tolna Coulee were reviewed and the results are included in Appendix B.*

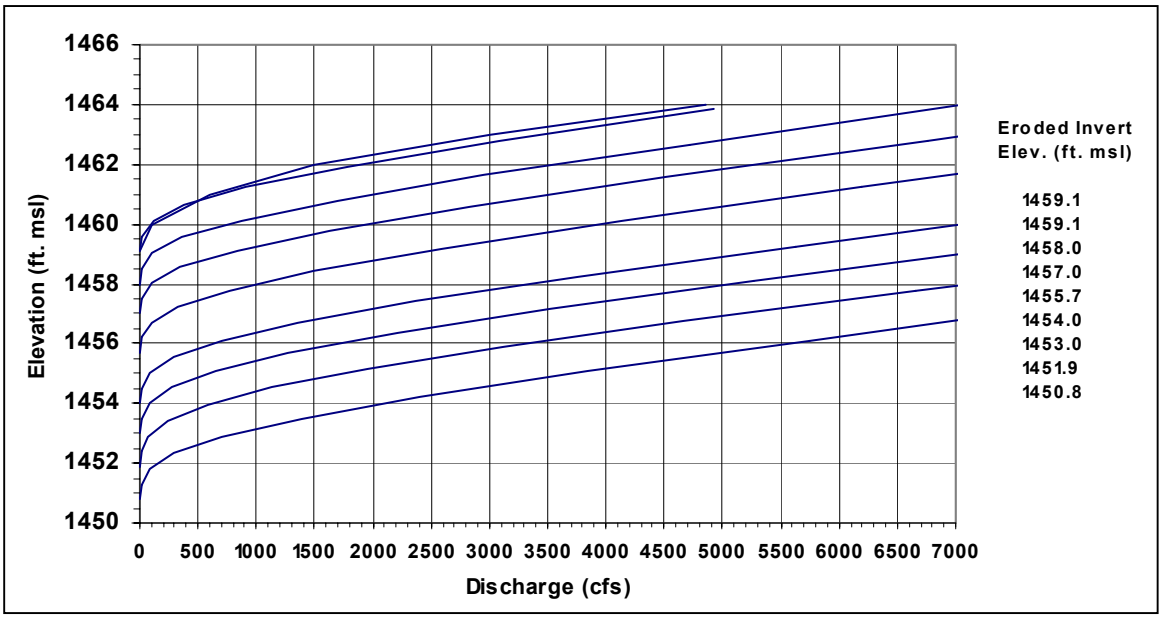

Figure 5-2: Stump Lake Outlet (Tolna Coulee) Elevation-Discharge Rating Curves

water quality impacts would also be experienced by surface water users along the Red River of the North in North Dakota, Minnesota, and Canada.

As the lake continues to rise, the chance of a natural spill becomes more likely. Such a natural spill would have significant impacts on the quantity and quality of water in the Sheyenne and Red Rivers. A controlled outlet to the Sheyenne River could avert this natural spill for most events; however, were a Standard Project Flood (SPF)[1] event to occur during lake levels above 1454, a controlled outlet would not be able to prevent the natural overflow. Because of the limited channel capacity of the Sheyenne River and the limitations on water quality in the Sheyenne and Red Rivers, operation of a controlled outlet is required over a long period of time. Without a long period of time to operate, the controlled outlet would have a very low chance of avoiding or even significantly reducing the natural spill potential.

A slight offset of the massive flood damages is the improved recreational fishery in the lake. Because of rising lake levels, fishing and waterfowl hunting have prospered. Devils Lake, known as one of the premier year-round fishing lakes in the Upper Midwest, has experienced an increase in the number of people from North Dakota and neighboring States to fish and hunt its expansive lake waters. This boom has helped mitigate damage to the local economy due to farmland loss.

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[1] *A Standard Project Flood (SPF) is defined as the most severe combination of meteorologic and hydrologic conditions that are considered reasonably characteristic of the geographic region involved, excluding extremely rare combinations. It is a hydro-meteorological event. Because Devils Lake is a terminal lake, hydro-climatological events are also relevant with respect to flood risk. So, effects of a hydro-climatological SPF should also be considered (see Appendix A, Section 2).*

Significant Resources

The scoping process identified the following 22 issues as significant. The degree to which they were analyzed in this Integrated Report/EIS depends on how they are affected by the proposed actions. The effects of the alternatives on significant resources are identified in the "Environmental Consequences" section. The significant resources are further grouped into broader categories for ease of discussion as indicated below.

Social Resources

Social
This issue includes impacts to neighborhoods, increases in stress and clinical depression due to the rising lake level and project impacts (such as property impacts and cultural and spiritual values), and the evaluation of the potential for impacts to environmental justice communities.

Economic
This issue includes questions about infrastructure impacts (such as sewers, roads, and levees), as well as specific issues around tax base, economic viability of businesses including farms, and the effects on agriculture and other businesses. It also includes treatment of cost-benefit and other standard economic analyses.

Water Users/Water Supply
This issue includes topics concerning irrigators, municipal and industrial water supply, water treatment facilities (capacity, potential need for upgrading and related costs), and issues affecting permitted dischargers, especially downstream.

Devils Lake Agriculture
This issue includes topics such as the effects of higher water tables, reduced land base, and soil salinity on agriculture in the Devils Lake basin currently affected by flooding. This issue is closely related to Economic Issues.

Downstream Agriculture
This issue includes topics such as the effects of higher water tables during outlet operation, potential problems at river crossings during high water, the nature and availability of water for livestock, and potential for bank erosion (related to Downstream Erosion and Sedimentation and to Groundwater).

Devils Lake Recreation
This issue includes potential effects on the recreational fishery at Devils Lake, as well as any boating hazards associated with the alternatives.

Downstream Recreation
This issue includes potential effects on the Sheyenne and Red Rivers, as well as Lake Ashtabula, and includes both fishery and boating (summer) recreation and snowmobiling and other winter recreation activities.

Water Quantity in Devils Lake
This issue covers most aspects of the current flooding issue. It includes consideration of future flooding potential, damage to public and private lands and infrastructure, effects on businesses (including those related to recreation), and consideration of low water levels as well as the current high water levels. The effects on the upper Devils Lake basin will also be included here.

Cultural Resources

Cultural Resources
This issue includes potential effects on archaeological and historical resources (including traditional cultural properties) that may be eligible for the National Register of Historic Places.

Natural Resources

Downstream Water Quality
This issue includes questions about sulfates, total dissolved solids, mercury, and other water quality parameters in the Sheyenne and Red Rivers.

Downstream Water Quantity
This issue includes downstream flooding both with and without storm events, effects on the operation of the fish hatchery at Lake Ashtabula, questions regarding specific water levels at specific locations on the Sheyenne and Red Rivers, and discussions of the application of flood modeling to impact predictions.

Downstream Natural Resources
This issue includes potential effects on designated special areas (such as scientific and natural areas, wetlands, wildlife areas, and forests), as well as any threatened or endangered species that may occur in the geographic scope of analysis.

Biota Transfer
This issue includes the potential for the transfer of biota from Devils Lake to the Sheyenne and Red Rivers and the potential for the introduction of invasive species.

Downstream Erosion and Sedimentation
This issue includes impacts to riverbanks and shorelines on the Sheyenne and Red Rivers, as well as Lake Ashtabula. It involves questions about bank stabilization (mitigation), severity of erosive effects, overbank flooding, elevation of the floodplain, effects on river stage, short- and long-term water level changes, and combined discharges.

Operational Issues
This issue includes numerous specific topics, including the nature of operational constraints or conditions (such as water quality standards, ice jams, or storm events); under what circumstances an outlet would "kick in" (elevation or other release triggers, seasonal or other operating windows); design pump capacity and direction of flow; fish entrapment; and notifications and other day-to-day operational parameters. Overall efficiency and effectiveness of the proposed outlet under various conditions are included as well.

Groundwater
This issue includes questions on the relationship of Devils Lake with the Spiritwood Aquifer, including water quality, water quantity, flood levels, and soil salinity. Effects of outlet operation on groundwater levels along the Sheyenne River are being analyzed.

Devils Lake Basin Natural Resources
This issue includes potential effects on designated special areas (such as scientific and natural areas, wetlands, wildlife areas, and forests), natural resources, and any threatened or endangered species that may occur in the geographic area.

Water Quality in Devils Lake
This issue includes sulfates, total dissolved solids, mercury, and other water quality parameters currently affecting the communities surrounding Devils Lake, including business and industry (agriculture and recreation). Water quality in Devils Lake is also related to operational constraints for an outlet and to downstream water quality.

Downstream Aquatic Resources
This issue includes topics related to fishery health, effects on riverbank (riparian) vegetation, Red and Sheyenne River fishery, mussels, and plankton and other nutrients.

Devils Lake Aquatic Resources
This issue includes potential effects on the recreational fishery in Devils Lake, along with water quality, bioaccumulation of mercury, plankton, and other nutrients.

Other States, Nations, and Tribal Resources

Canada and Minnesota
This issue includes topics such as conformity with the 1909 Boundary Waters Treaty with Great Britain and certain specific topics of interest to the State of Minnesota.

Spirit Lake Tribe
This issue concerns a number of topics, including sovereignty determinations; Tribal Trust resource status; nature and location of any cultural resources (including Traditional Cultural Properties) that might be eligible for the National Register of Historic Places; economics; environmental justice; decisions arising from litigation concerning boundaries of the Fort Totten Indian Reservation; and impacts on groundwater under the reservation.

EXISTING CONDITIONS/AFFECTED ENVIRONMENT

(*Much of the following is a summary of detailed information presented in the technical appendices of this report. The reader is referred to the appropriate technical appendix for a detailed discussion of the existing resource conditions.)*

Devils Lake Basin

Natural Resources

The Devils Lake basin is the result of the last advance of continental ice sheets in North Dakota. Glacial Devils Lake was maintained at about elevation 1450 feet msl by glacial meltwater flowing from the retreating ice sheet to the north, by precipitation, and by snowmelt water. Several coulees provide drainage for the basin, delivering water to the Devils Lake chain. Mauvais Coulee, the largest drainage channel in the Devils Lake system, is a tributary to Lakes Alice and Irvine. Water flows in Mauvais Coulee intermittently, largely in response to precipitation and, to a lesser extent, to land use changes such as agricultural practices, wetland drainage, and road construction. Big Coulee flows through Pelican Lake and into West Bay Devils Lake.

Devils Lake supports a valuable sport fishery, which greatly improved during the 1980s and 1990s with rising water levels. Devils Lake is a brackish lake, affected by lake level fluctuations, which are beneficial to the support of the current fishery. Primary species pursued by anglers are walleye, northern pike, yellow perch, and white bass. White suckers and black bullheads are also present but not at population levels sufficient to degrade the quality of the sport fishery. At lower lake levels, because of low natural reproduction due to brackish water quality, most of the game fish populations were maintained through stocking. With current high lake levels freshening the lake, many species are experiencing successful natural reproduction. Forage species such as fathead minnows have increased dramatically with the high lake levels.

Wildlife in the Devils Lake basin is closely associated with water and wetlands. Shallow-water wetland habitats are clearly the most valuable habitat types for waterfowl. Many wildlife and waterfowl species utilize lakes in the Devils Lake chain and surrounding habitats. Stump Lake has long been known as an excellent staging and breeding area for waterfowl and shorebirds. In 1905, President Theodore Roosevelt declared a portion of the west bay of Stump Lake a National Reservation, making it one of the oldest refuges in the nation.

The Devils Lake basin and downstream rivers also provide breeding or migratory habitat for a number of federally listed threatened or endangered species, including the bald eagle, whooping crane, gray wolf, piping plover, and western prairie fringed orchid.

Based on the percent of any individual county within the basin, it is estimated that there are about 200,000 acres of Conservation Reserve Program (CRP) lands within the basin. These lands provide significant wildlife habitat and reduce the volume of runoff into the coulees that flow into the lake.

The States of North Dakota and Minnesota have developed lists of natural heritage sites, which exhibit significant natural or cultural values. These include wildlife and vegetation species, vegetation types, and aquatic resources. Over 300 such sites are listed around Devils Lake and within ¼ mile of the Sheyenne and Red Rivers.

The dominant land use around Devils Lake up to elevation 1463 is agriculture, with 48 percent of the land classified as such. Other land uses include woodland (5 percent), grassland (21 percent), wetland (25 percent), and urban (1 percent).

In summary, the main Devils Lake chain consists of an excellent sport fishery and provides habitat for a wide range of aquatic, wildlife, and avian species. The recreational opportunities provided by the lake result in tremendous economic value to the area.

Appendix C presents a detailed discussion of existing natural resource conditions.

Social Resources

Population has been declining in the basin for the past two decades. All six of the counties had population decreases over the period 1980-1996, ranging from 4.5 percent in Ramsey County to 31 percent in Cavalier County, with a decrease of 16.5 percent for the basin. All counties registered substantial out-migration during the 1980s, which has been reversed only in Eddy County during the period 1990-1996. The largest county is Ramsey, with a 1996 population of 12,455.

One result of the area's pattern of net out-migration is a population with a high proportion of older residents. In 1996, more than 20 percent of the basin residents were over age 65, compared to 14.5 percent statewide. All counties except Benson and Ramsey had 21 percent or more of their residents over age 65.

Most basin communities reflect the declining population trends. From 1980 to 1990, the cities of Devils Lake, Cando, and Fort Totten showed population gains. However, from 1990 to 1996, all of the area's towns experienced population declines. The largest city in the basin is Devils Lake, which dominates retail trade in the area; it had a 1996 population of 7,672.

The 1996 population of the area was approximately 89 percent white and 11 percent Native American. The Native American population is concentrated in Benson and Ramsey Counties. Benson County is the location of the Fort Totten Indian Reservation. The reservation had a 1990 population of 3,588, of which 74 percent were Native Americans.

A major factor contributing to the decline of the smaller communities in the basin is the continuing decrease in the number of farms in all of the area's counties. From 1982 to 1992, farm numbers in the basin decreased 20 percent, with the decline ranging from 9.6 percent in Eddy County to 25.9 percent in Ramsey County. Because most of the area's communities function primarily as agricultural trade centers, declining farm numbers reflect a declining clientele base for many trade and service businesses.

Nevertheless, agriculture continues to be the dominant sector of the Devils Lake area economy. In 1996, agriculture accounted for 48 percent of the area's economy, followed by Federal Government outlays (38 percent), tourism (10 percent), and manufacturing (3 percent). Tourism has been the fastest growing component of the area's economic base, increasing from 3 percent in 1980 to 10 percent in 1996. Tourism is particularly important in Ramsey County, having reached nearly two-thirds the importance of agriculture in 1996. The tourism figures are understated because they account only for the expenditures of travelers from out of state.

Cultural Resources

Only portions of the Devils Lake shoreline (e.g., recreation areas, Grahams Island State Park, City of Devils Lake levee alignments) between elevations 1444 and 1465 have been surveyed for cultural resources. Known cultural resources sites along the Devils Lake shoreline between elevations 1444 and 1447 include four prehistoric archeological sites, six historic archeological sites, and ten architectural/standing structure sites. Three of these sites have been determined eligible for the National Register of Historic Places.

Known cultural resources sites along the Devils Lake shoreline between elevations 1447 and 1465 include nine prehistoric archeological sites, six historic archeological sites, and sixteen architectural/standing structure sites. This group of sites contains one National Register eligible site and two National Register listed sites (Benson County Courthouse and Grace Episcopal Church in Minnewaukan). There are also unverified leads to four prehistoric archeological sites, eight historic archeological sites, and twelve architectural sites in the Devils Lake area between elevations 1444 to 1465.

Less than 10 percent of the Stump Lakes vicinity and the channel connecting East Devils Lake with Stump Lakes between elevations 1407 and 1465 has been surveyed for cultural resources. Three small areas have been surveyed along Tolna Coulee. One prehistoric archeological site and one historic archeological site are recorded for the Stump Lakes area between elevations 1407 and 1447. One additional prehistoric archeological site and one architectural/standing structure site are recorded from elevations 1447 to 1465. There are no sites recorded for the connecting channel below 1460. One prehistoric archeological site is recorded for Tolna Coulee. There are no National Register eligible or listed sites for these areas. There is one unverified lead to a prehistoric archeological site between 1460 and 1465 at Stump Lakes and an unverified lead to a historic archeological site near the mouth of Tolna Coulee.

See Appendix C for detailed information on existing cultural resource conditions.

Other States, Nations, and Tribal Resources

The Fort Totten Indian Reservation is located south of Devils Lake. The reservation encompasses about 383 square miles between Devils Lake and the Sheyenne River. Numerous cultural sites and resources are located on the reservation, and traditional cultural properties are important resources (see Cultural Resources Section above). Native Americans use plants and animals for food, medicinal, and ceremonial purposes. Some of the important species include bald eagle, ironwood, sage, cedar, wild rice, and tobacco.

The U.S. Environmental Protection Agency conducted an Environmental Justice analysis in the project area. It found that, in the Devils Lake Region, there is one federally recognized tribe, the Spirit Lake Nation Sioux Tribe, south of Devils Lake. Other areas of Devils Lake do not include federally recognized tribes or significant populations of communities of color. Based on the percent of those living in poverty as compared to the state average, areas west and southwest of Devils Lake and in downstream areas are considered low-income communities, according to U.S. Census data.

Sheyenne River

Natural Resources

The Sheyenne River is one of four major North Dakota tributaries to the Red River, with a watershed of 6,910 square miles. The upper reach of the river is a narrow and relatively small river with intermittent flows ranging from flood, usually in the spring, to occasional no flow in the summer. The channel capacity is estimated at about 600 cfs upstream of Lake Ashtabula.

Lake Ashtabula is a popular recreation area located about midway along the river's length. Boating, swimming, and fishing are popular activities in the 5,430-acre reservoir.

The river from Lake Ashtabula to just below Lisbon flows through a valley ½ to 1 mile wide and as deep as 200 feet, through glacial till and Cretaceous Niobrara and Pierre Formations. The river segment from Lisbon to the confluence with the Red River crosses the Sheyenne Delta, through an extensive sandhills area and the floor of glacial Lake Agassiz, forming the Red River Valley.

Land use in the riparian zone of the Sheyenne River is predominantly woodland, grassland, and cropland, depending on the location. The lower reach of the Sheyenne River flows through the Sheyenne Delta, which is one of the more heavily forested areas of the state. The Delta area also contains a number of state listed Species of Concern.

Land use within ¼ mile of the Sheyenne River is distributed as follows: 33 percent cropland, 18 percent woodland, 36 percent grassland, 1 percent grass-shrub, 10 percent wetland, and 2 percent urban.

The Sheyenne National Grasslands, managed by the U.S. Forest Service, is also located in the Delta area. The Sheyenne River flows through a unique natural area in southeastern North Dakota known as the Sheyenne Sandhills. The Sandhills are home to 17 different State-listed unique, rare, or special concern plant, animal, or bird species or habitat types. The Mirror Pool Wildlife Management Area, located in the Delta, is the largest fen or peatland on the Sheyenne River.

The Sheyenne Delta area, and primarily the Sheyenne National Grasslands, supports the largest population of the federally threatened western prairie fringed orchid in North Dakota. The orchid is located primarily in the area of the Sheyenne National Grasslands between Anselm and Kindred, North Dakota. The orchid is not found in the floodplain of the Sheyenne River, but in low-lying swales in upland areas more than 1 mile from the river.

The State of North Dakota has developed a list of natural heritage sites, which exhibit significant natural or cultural values. These include wildlife and vegetation species, vegetation types, and aquatic resources. There are 857 natural heritage sites listed in the Sheyenne River basin.

The Sheyenne River provides spawning habitat and nursery areas for forage fish, as well as a migrational avenue for sport fish, including channel catfish, northern pike, walleye, bass, and crappie especially during high water conditions. The Sheyenne River contains more species of fish than any other North Dakota tributary, with over 50 species identified. The river itself and a number of small reservoirs created by low-head dams provide fishing opportunities for nearby residents. About 3 percent of the angler-days of fishing in North Dakota are spent on the Sheyenne River. Commonly harvested fish include northern pike, walleye, channel catfish, black bullhead, yellow perch, and bluegill. Baldhill Creek, a tributary to the Sheyenne River, contains the only known population of trout-perch in North Dakota. There are nine species of freshwater mussels inhabiting the Sheyenne River.

The riparian areas along the Sheyenne River provide valuable habitat for a variety of wildlife species. Game species found along the river's riparian corridor and adjacent uplands include white-tailed deer, moose, wood duck, dabbling duck, pheasant, greater prairie chicken, turkey, squirrels, and rabbits. Furbearing species and migratory non-game birds use the river corridor for breeding, feeding, and migration.

In summary, the Sheyenne River valley provides significant and unique aquatic and terrestrial resources. It is one of the most heavily wooded areas of the State and contains one of the largest, most diverse fisheries.

Water Use from the Sheyenne River

There are approximately 53 permitted users of water from the Sheyenne River. Of the 53 permits, 3 are for fish and wildlife purposes, 3 for recreation, and the remainder for irrigation. Valley City and Fargo both use the Sheyenne River for municipal water supply. The Valley City Public Works Water Treatment Facility was built in 1972 and has a capacity of 4.0 million gallons per day (MGD). The facility serves a population of 7,400 people with an average water usage of 1.0 MGD. During most of the year, the raw water is taken directly from the Sheyenne River. During the summer, taste and odor problems resulting from elevated algae levels in the Sheyenne River make that water undesirable. As a substitute, during periods of high algae levels, raw water is instead obtained from wells located adjacent to the river. The wells are shallow and only 48 feet from the river.

The City of Fargo normally draws its municipal water from the Red River. The Sheyenne River is used as a secondary intake source as needed. The City of Fargo also has a permit to withdraw water from Lake Ashtabula in case of an emergency.

Social Resources

The Sheyenne River portion of the study area includes the counties (and cities) of Steele, Barnes (Valley City and Kathryn), Ransom (Fort Ransom and Lisbon), Griggs (Cooperstown), and Richland. Population in this primarily rural area has declined over the period 1980-2000 ranging from a 6-percent decrease for Richland County to a 27-percent decrease for Steele County. Population is projected to continue decreasing in the future for all counties except Richland County for which moderate growth is anticipated. From 1990 to 2000, the population of Lisbon grew by 5 percent, while the other cities located farther upstream all experienced population declines.

Growth in median household income from 1993 to 1997 for Barnes (16.5 percent) and Ransom (16.1 percent) Counties was comparable to the State of North Dakota as a whole (16.2 percent). Griggs (11.9 percent) and Steele (11.5 percent) Counties lagged behind the state growth trend, while Richland County (18.7 percent) experienced faster growth. Comparatively, median household income for the United States as a whole grew 18.5 percent during this period and the Consumer Price Index for the Midwest region increased by 11.9 percent.

The industry with the greatest level of employment in the local area is retail trade. Following this is the wholesale trade industry, accommodation and food services, health care, and government. Manufacturing is significant in Richland County. As of September 2001, unemployment is relatively low among the counties along the Sheyenne River. Unemployment ranges from 0.7 percent for Steele County to 1.6 percent for Richland County. Comparatively, unemployment was 1.7 percent for North Dakota and 4.9 percent for the United States.

Cultural Resources

Less than 25 percent of the area along the banks of the Sheyenne River has been previously surveyed for cultural resources, with most work concentrating in Ransom (Fort Ransom-Lisbon areas), Barnes (Lake Ashtabula), and Griggs (Lake Ashtabula and upstream to Highway 200) Counties. There are 161 prehistoric archeological sites, 34 historic archeological sites, and 57 architectural/standing structure sites recorded within ¼ mile from the Sheyenne River channel between the preliminarily selected Devils Lake outlet at Peterson Coulee in Benson County and its confluence with the Red River north of Fargo in Cass County. Included in the above site totals is one historic district determined eligible for the National Register, as well as two historic districts (Biesterfeldt and T.J. Walker) and eight individual sites (seven bridges, Lisbon opera house) listed on the National Register. In addition, there are unverified leads to 77 prehistoric archeological sites, 65 historic archeological sites, and 5 architectural sites for this same stretch of riverbanks.

A canoe-based reconnaissance of the cutbanks of the Sheyenne River (minus the Lake Ashtabula shoreline) in the fall of 2000 and the spring of 2001 recorded 46 prehistoric archeological sites and relocated 9 previously recorded archeological sites, all 55 of which are visibly eroding out of the river's cutbanks. In addition, 14 architectural/standing structure sites (3 dams, 8 bridges, 3 structures) were also recorded along this stretch of river. No human burials, graves, or mounds were observed in or at the river's banks. Natural erosion along the Sheyenne River's banks is no doubt affecting more archeological sites than those where eroding artifacts were observed during this reconnaissance survey.

Other States, Nations, and Tribal Resources

The Fort Totten Indian Reservation extends to the Sheyenne River and is located downstream of Peterson Coulee for about 55 river miles. Cultural sites are located along the river. Important plant and animal species used for food, medicinal, spiritual, or ceremonial purposes are also located along the river.

Red River of the North

Natural Resources

The Red River of the North is a part of the Hudson Bay drainage system in parts of North Dakota, South Dakota, and Minnesota. The entire drainage area consists of about

39,200 square miles. The Red River flows north into Canada across the floor of the glacial lakebed for 424 river miles between the confluence with the Sheyenne River and Lake Winnipeg. The lakebed is nearly flat, with an average slope of about 0.5 foot per mile. The river has a high sediment load of silts and clays and is characterized by a low gradient and high sinuosity.

The Red River provides spawning habitat and nursery areas for forage fish, as well as a migrational avenue for sport fish. The Red River has been identified as one of the highest quality channel catfish fisheries in the Nation. Eight species of freshwater mussels are found in the Red River.

Although the habitats supporting fish and wildlife resources along the Red River have been substantially altered, the remaining areas provide several important functions. Shelterbelts and riparian woodlands provide denning and nesting sites, food, escape and winter cover, and travel lanes for many wildlife and waterfowl species.

The Red River is characterized as a riverine, lower perennial, unconsolidated bottom, and permanently flooded wetland. Unlike the Sheyenne River, the Red River floodplain is largely void of palustrine emergent wetland types. Red River floodplain wetlands are typically old river scars and oxbows.

Land use along the Red River is dominated by agricultural uses. Land use within ¼ mile of the Red River is distributed as follows: 62 percent cropland, 19 percent woodland, 5 percent grassland, 11 percent wetland, and 3 percent urban.

The Devils Lake basin and downstream rivers also provides breeding or migratory habitat for a number of federally listed threatened or endangered species. Table 5-1 is a list of these species and the North Dakota and Minnesota counties in which they occur.

Water Use from the Red River of the North

Communities that are known to currently use water from the Red River of the North as a municipal water supply are the North Dakota cities of Fargo, Grand Forks, Grafton, Drayton, and Pembina and the Canadian cities of Letellier, Morris, and communities served by the Pembina Valley Water Cooperative.

Fargo's water treatment facility was constructed in 1997 and currently serves a population of approximately 85,000 people. Fargo has a primary intake source on the Red River of the North and a secondary intake source on the Sheyenne River. The intake on the Red River is located upstream of the confluence with the Sheyenne River. The Fargo treatment facility also has a permit to withdraw water from Lake Ashtabula should it become necessary due to emergency conditions. The facility has a peak rated capacity of 30 million gallons per day (MGD) and an average rated capacity of 14 MGD. The average daily water use rate has been approximately 11.5 MGD.

Table 5-1: County Occurrence of Threatened and Endangered Species in North Dakota and Minnesota

SPECIES \ COUNTIES	Ramsey, ND	Benson, ND	Towner, ND	Cavalier, ND	Nelson, ND	Walsh, ND	Sheridan, ND	Wells, ND	Eddy, ND	Griggs, ND	Barnes, ND	Ransom, ND	Richland, ND	Cass, ND	Gr.Forks, ND	Pembina, ND	Traill, ND	Clay, MN	Norman, MN	Polk, MN	Marshall, MN	Kittson, MN
Devils Lake Counties																						
Bald Eagle – T	X	X	X	X	X	X																
Whooping Crane – E		X	X	X																		
Gray Wolf – E			X	X		X																
Piping Plover –T		X																				
Sheyenne River Counties																						
Bald Eagle – T		X			X		X	X	X	X	X	X	X	X								
Whooping Crane – E		X					X	X	X	X	X											
Piping Plover – T		X					X	X	X													
W. P. Fringed Orchid – T												X	X									
Red River Counties																						
Bald Eagle – T						X							X	X	X	X	X			X	X	X
Whooping Crane – E																						
Piping Plover – T																						
W. P. Fringed Orchid – T													X					X	X	X		X
Gray Wolf – E North Dakota T Minnesota						X									X	X				X	X	X
Canada Lynx – T																						X

The City of Grand Forks water treatment facility, installed in 1897, has undergone several upgrades over the years. The facility has a capacity of 16.5 MGD, but produces an average of 8.0 MGD and serves 55,000 people. Grand Forks obtains approximately 60 percent of its raw water from the Red Lake River and approximately 40 percent from the Red River of the North. Water from the two sources is blended, with the exact proportions depending on the water quality in each river.

The Grafton water treatment facility, installed in 1954, serves 5,000 people and has a facility capacity of 3.0 MGD. The daily average water usage was 0.7 MGD in 1997, with approximately 90 percent of the facility's raw water coming from the Red River of the North and 10 percent from the Park River.

The Drayton water treatment facility was installed in 1962, with several expansions and upgrades since then. The city uses the Red River of the North as its sole raw water source for its population of approximately 1,000 people. The maximum capacity of the facility is 0.72 MGD and the average raw water intake is 0.25 MGD.

The City of Pembina currently serves approximately 650 people and uses the Red River of the North as its raw water source. The facility was constructed in 1970 and has a maximum capacity of 0.58 MGD. The average daily water usage is 0.17 MGD. In emergency situations, Pembina can obtain water from a rural water supplier.

Pembina Valley Water Cooperative, Inc. (PVWC) uses the Red River as a source of potable water on the Canadian side of the border. It operates two state-of-the-art water treatment plants on the Red River: a 100-litre-per-second (2.2 MGD) plant at Letellier, and a 35-litre-per-second (0.8 MGD) plant at Morris. These plants provide drinking water to a population base approaching 40,000 and in the majority of these communities are the sole source of supply. Major conveyance pipelines run up to 40 miles west and 10 miles east from these plants, providing water to municipal distribution systems. PVWC is owned by 17 municipal governments.

Three industrial water users on the Red River of the North have been identified that may be affected by a change in water quality due to the introduction of Devils Lake water. They include a paper mill and a sugar beet processing facility that use the river water to supplement processing, and a power plant that uses the river water as cooling water, to transport fly ash and as boiler make-up.

There are an additional 148 permitted water users on the Red River of the North, with 76 of these in Canada, 23 in Minnesota, and 49 in North Dakota. Water is used for irrigation, domestic purposes, waterfowl conservation, and a golf course.

There are also non-permitted river water users on the Red River of the North. In North Dakota, a water-use permit is required for any water user irrigating more than 1 acre, or withdrawing more than 12.5 acre-feet of water per year (approximately 11,000 gallons per day) from the river. In Minnesota, a water-use permit is not needed if withdrawal is less than 10,000 gallons per day or if the water is used for domestic purposes and serves less than 25 people. Non-permitted users for the Canadian reach of the Red River of the North would include those river users who withdraw less than 5,000 imperial gallons per day (approximately 6,000 U.S. gallons per day), based on Manitoba's permit requirements. Although the number of potentially affected river water users or the quantity of use among this group of non-permitted users is uncertain, the types of use appear to include domestic, livestock, lawns and gardens, vegetable crops, and recreational.

Social Resources

The Red River of the North portion of the study area includes the counties (and cities) of Cass (Fargo, West Fargo), Traill, Grand Forks (Grand Forks), Walsh, and Pembina in North Dakota and Clay (Moorhead), Norman, Polk (East Grand Forks), Marshall, and Kittson in Minnesota. Population has declined in recent years for most of these counties. The exception is Cass County where Fargo, the largest city in North Dakota, is located. From 1980 to 2000, the county population grew by 40 percent. Grand Forks County's population was also growing until the flood of 1997 occurred. As a result, the 2000 population level was unchanged from 1980 levels. Population is projected to decline for most counties along the Red River. The exceptions are Cass County in North Dakota and Clay County in Minnesota, which are dominated by the Fargo-Moorhead metropolitan area, and Traill County, which is situated between Fargo and Grand Forks.

Median household income varies fairly significantly among the counties along the Red River of the North, ranging from $32,890 for Norman County to $43,311 for Cass County. Growth in median household income has also varied significantly. From 1993 to 1997, growth ranged from 6.8 percent for Walsh and Kittson Counties and 8.6 percent for Norman County to 20 percent for Clay and Traill Counties. These figures compare with growth of 16.2 percent in North Dakota, 25.1 percent in Minnesota, and 18.5 percent for the United States as a whole.

The primary economic sectors in terms of employment are retail and wholesale trade. Other important sectors include accommodation and food services, health care, and manufacturing. Unemployment among the counties is relatively low compared to the Nation as a whole. Unemployment (as of September 2001) ranged from 0.9 percent for Cass County to 4.2 percent for Marshall County. As a whole, the area's unemployment averaged 1.6 percent, while unemployment for the United States amounted to 4.9 percent.

Cultural Resources

Cultural resources surveys along the Red River have been conducted primarily in Norman and Polk Counties in Minnesota and in Grand Forks County in North Dakota. Previous surveys along the Red River have located archeological sites both on the surface and buried up to 3 meters (10 feet) below the present ground surface. Sites tend to be concentrated on the terraces and lake plain uplands within ¼ mile of the river, but are also located along old river oxbows and secondary channels.

Other States, Nations, and Tribal Resources

The State of Minnesota borders the eastern side of the Red River to the Canadian border. Minnesota has identified significant plant and animal resources along the Red River corridor. The Red River is an important aquatic resource for Minnesota. A significant catfish fishery exists in the Red River, primarily downstream of Grand Forks. Canada has identified significant cultural, social, aquatic, water user, and natural resource values

along the Red River in Canada. Biota transfer is an important issue to both the State of Minnesota and Canada.

Future Without-Project Conditions

The future without-project conditions are defined as the most likely conditions to occur in the project area in the absence of the implementation of the proposed action and is considered to be a continuation of the existing conditions described in Chapters 3, 4, 5, and 6 of this report. Infrastructure protection measures such as levee construction, road raises, relocations, abandonment, and other actions would continue in the future as needed if the lake continues to rise. These actions have occurred over the last several years in response to rising lake levels and are expected to continue regardless of other actions that may take place. The social, environmental, economic, and cultural effects associated with these actions would continue as described under the existing conditions in Chapter 5 above and in Chapter 6, "Future Without-Project Conditions." The hydrologic future is described under the stochastic and scenario futures. Under the stochastic future, there is a 9.4-percent chance that the lake will overflow and is considered to be unlikely. A scenario future is presented as an alternative hydrologic future to the probabilistic approach. The scenario future is not based on probability and it is assumed that the lake would overflow to the Sheyenne River within about 15 years.

For the purposes of the environmental analysis and determination of mitigation needs, the future without-project conditions are based on the assumption of no natural overflow.

Planning Objectives

The national objectives, which guided this study, are expressed in the Water Resources Council's Principles and Standards for *Planning Water and Related Land Resources*, (1973):

> The overall purpose of water and lands resource planning is to promote the quality of life, by reflecting society's preferences for attainment of the objectives defined below:
>
> A. To enhance national economic development by increasing the value of the Nation's output of goods and services and improving national economic efficiency.
>
> B. To enhance the quality of the environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

The specific planning objectives for this study were to develop a plan to address the flood damage problems around Devils Lake that are associated with potential future lake level rises while minimizing downstream effects on the Sheyenne and Red Rivers. The

following planning objectives guided the development, evaluation, and selection of alternatives in this study.

1) Minimize further flood damages around Devils Lake.

2) Minimize the potential of uncontrolled flows into the Sheyenne River.

3) Be flexible to operate over a range of Devils Lake inflows and channel capacity and water quality conditions downstream in the Sheyenne and Red Rivers.

4) Be flexible to deal with increased flood risks associated with elevated lake levels.

5) Avoid to the maximum extent possible, or mitigate, adverse impacts.